MODERN MECHANICS AND INVENTIONS

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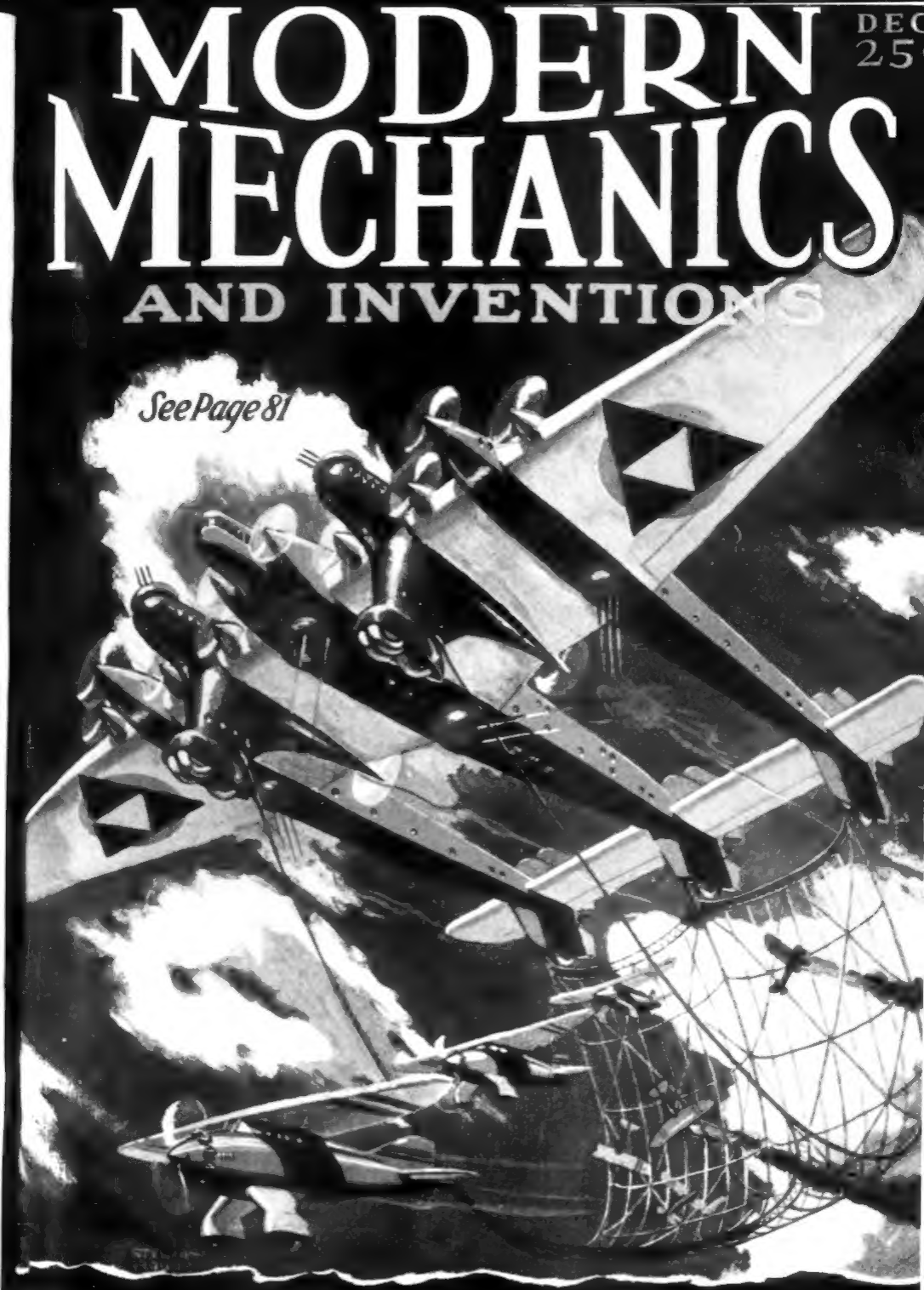

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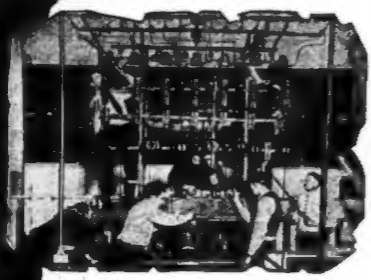

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DECEMBER 1928

Vol. I No. 7

MODERN MECHANICS AND INVENTIONS

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EDITED BY EXPERTS

Listed below are the members of the Modern Mechanics board of editors, all qualified by national repute to serve as authorities. They will gladly answer questions from our readers concerning their departments. Address them in care of this magazine, Robbinsdale, Minn.

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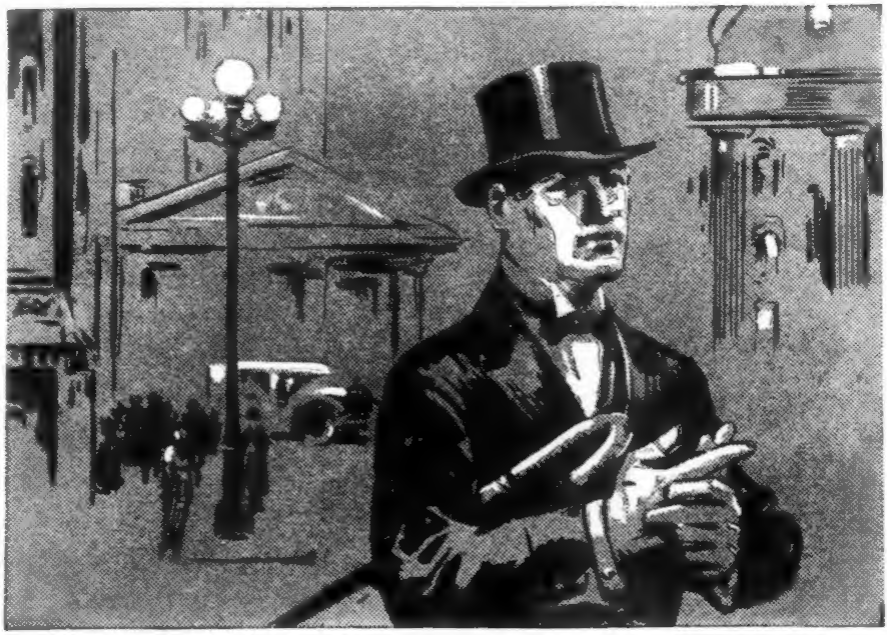
Frontispiece by Chester M. Sullivan, illustrating "Gangland's Death Machines"



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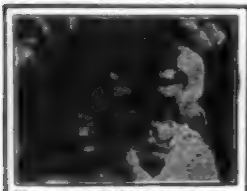

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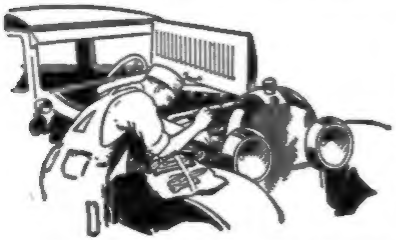

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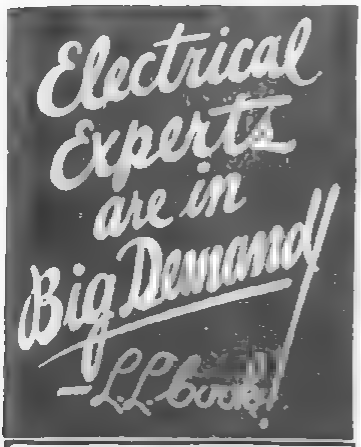

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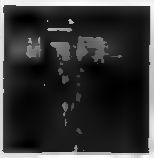

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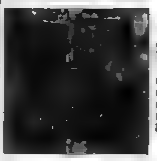

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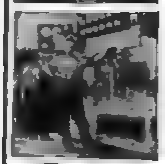

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"When I began with you I was just a common laborer, going from one job to another, working for anything I could get, and that wasn't much. Now my salary is $3,500 a year and the Company furnishes me with an automobile."
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Be an Electrical Expert
Earn $3,500 to $10,000 a Year

Today even the ordinary Electrician—the "screw driver" kind—is making money—big money. But it's the trained man—the man who knows the whys and wherefores of Electricity—the Electrical Expert—who is picked out to "boss" the ordinary Electricians—to boss the Big Jobs—the jobs that pay $3,500 to $10,000 a Year. Get in line for one of these "Big Jobs." Start by enrolling now for my easily learned, quickly grasped, right-up-to-the-minute, Spare-Time Home-Study Course in Practical Electricity.

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You don't have to be a College Man; you don't have to be a High School Graduate. As Chief Engineer of the Chicago Engineering Works, I know exactly the kind of training you need and I will give you that training. My Course in Electricity is simple, thorough and complete and offers every man, regardless of age, education or previous experience, the chance to become, in a very short time, an "Electrical Expert," able to make from $70 to $200 a week.

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With me, you do practical work—at home. You start right in after your first few lessons to work at your profession in the regular way and make extra money in your spare time. For this you need tools, and I give them to you—5 big complete working outfits, with tools, measuring instruments and a real electric motor.

Your Satisfaction Guaranteed

So sure am I that you can learn Electricity—so sure am I that after studying with me, you, too, can get into the "big money" class in Electrical work, that I will guarantee under bond to return every single penny paid me in tuition, if, when you have finished my Course, you are not satisfied it was the best investment you ever made. And back of me in my guarantee, stands the Chicago Engineering Works, Inc., a two million dollar institution, thus assuring to every student enrolled, not only a wonderful training in Electricity, but an unsurpassed Student Service as well.

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MEN NEEDED IN ELECTRICITY

Salaries of $12 to $30 a day not unusual

No profession offers greater opportunity today than Electricity. Salaries of $13 to $30 a day are not uncommon and the opportunity for advancement is unlimited.

For this is the Electrical Age. New uses for electricity are being discovered every year. The growth of Radio is simply one illustration of the progress that is yet to be made.

As Forrest Crissey said in "The Saturday Evening Post"—"The demand for electrical work is increasing immensely and electrical contractors assert that the supply of electrical workers cannot overtake the demand for several years to come."

READ WHAT EDISON RECOMMENDS

The electrical wizard says: "Sometimes fathers come to me or write to me about their sons and want to know if in view of the fact that so much of the field of work is already occupied by electricity I would recommend it as a career.

"Well, if I were beginning my career again I should ask no better field in which to work. The chances for big new electrical inventions are much greater than before the telegraph, the telephone, the electric light, and the electric motor were invented, while each of these things is far from perfect."

Now is the time to prepare for a good position in this profitable, interesting profession.

Best of all, you can study right at home in spare time through the International Correspondence Schools—just as so many other men have done. These courses are the most complete and authoritative courses ever offered—endorsed by both Thomas A. Edison and the late Dr. Charles P. Steinmetz.

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Every student who is graduated from the Electrical Engineering Course of the International Correspondence Schools is given a diploma. This diploma is difficult to earn and its value is correspondingly high. It has been of inestimable value in helping men in all walks of life to secure good positions.

These well-known men helped to write the Course

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E. A. FLETCHER—Electrical Engineer, New Business Department, Alabama Power Co.
E. B. CRAIG, A.B., M.E.—Engineer of Distribution, Commonwealth Edison Co., Chicago.
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G. E. PARHAM, M.E.—Electrical Engineer, General Electric [redacted]
O. F. BRACKEN, B.S.—General Inspector of Sub-stations, Commonwealth Edison Co.
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Just mark and mail the coupon printed below and full information about Electrical Engineering, Electric Lighting, Electric Wiring, Electric Railways, Radio or any other work of your choice will come to you by return mail. Today—not Tomorrow—is the day to make that all-important start toward success.

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Without cost or obligation, please tell me how I can qualify for the position, or in the subject, before which I am marking X

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- ☐ Architectural Draftsman
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These are steady positions. Strikes, poor business conditions, lockouts or politics do not affect them. U. S. Government employees get their pay for full twelve months every year. There is no such thing as **"Hard Times"** in the U. S. Government Service.

ALLOWANCE FOR HOTEL EXPENSES

Railway Postal Clerks now get $1900 the first year, being paid on the first and fifteenth of each month. $79.16 each pay day. Their pay is increased $100 and $150 a year. The maximum is $2700 a year, $112.50 each pay day. They get extra allowance for hotel expenses when away from home.

PAID VACATIONS

Railway Postal Clerks, like all Government employees, are given a yearly vacation of 15 working days (about 18 days). When on runs they usually work 3 days and have 3 days off duty or in the same proportion. During this off duty and vacation, their pay continues just as though they were working. When they grow old, they are retired with a pension. As Railway Postal Clerks are continually traveling, they have an excellent chance to see the country. They are furnished with a railroad pass for official business.

City Mail Carriers—Post Office Clerks

Clerks and Carriers get $1700 the first year regular and automatically increase $100 a year to $2100 with further increase to $2300. They also have 15 days vacation. Examinations are frequently held in the larger cities. City residence is unnecessary.

What Will You Earn 5 Years from Now?

Compare these conditions with your condition, perhaps changing positions frequently, no chance in sight for PERMANENT employment; frequently out of a position. DO YOU EARN $1900 EVERY YEAR? HAVE YOU ANY ASSURANCE THAT A FEW YEARS FROM NOW YOU WILL GET $2700 OR MORE A YEAR, EVERY YEAR?

Get Free List of Positions

Fill out the coupon. Tear it off and mail it today—now, at once. DO IT NOW—This investment of two cents for a postage stamp may result in you getting a U. S. Government Job.

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Rush to me entirely free of charge 32 page book with (1) a full description of the position checked below; (2) Specimen coaching; (3) a list of U.S Government Jobs now obtainable; (4) Tell me how to get the position checked

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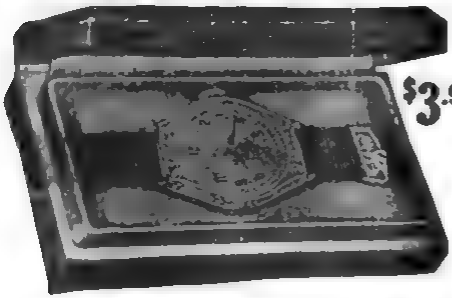
Buy your watches direct from importer and save 50%

Newest Style Wrist Watch With Two Bracelets



$3.99

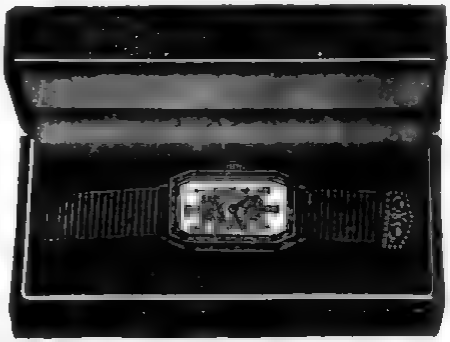
Really the Greatest Bargain in America Today

Storekeepers and Installment Mail Order Houses charge $12.00 for this very watch—We import watches direct from Switzerland and [illegible] newest, dainty, fashionable, ladies' watch. White Gold finish, engraved case, fully jeweled movement—Silk gros-grain ribbon for day wear and white gold effect link bracelet for evening and party wear. An accurate timekeeper and a Bargain at $3.99. Send No Money. Pay on Delivery. Fill in Coupon below.

Our Written Guarantee with Each Watch

We guarantee each and every watch to be in first class, accurate, time-keeping order, and with proper use and care to remain so for a lifetime.

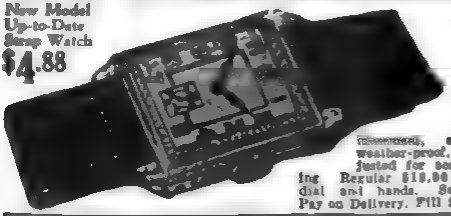
We guarantee to refund money in full, or replace any watch that does not prove perfectly satisfactory to you in every way.



NEW DESIGN WRIST WATCH RECTANGULAR SHAPE $4.96

Everyone will admire this elegant and artistically designed small and narrow shaped 6 jewel wrist watch. Platinoid or white gold effect case, handsomely engraved finish top, gracefully carved sides. Fitted with genuine Swiss movement of the finest quality, guaranteed for accuracy and dependability. Every wheel, spring, screw and jewel flawlessly finished. Furnished with two bracelets; a black silk gros-grain ribbon for [illegible] and a white gold finish link bracelet for evening and party wear. A real $20.00 value. Send No Money. Pay on Delivery. Fill in Coupon.

New Model Up-to-Date Strap Watch $4.88



Your choice in square, rectangular or tonneau shape at same price. White gold effect richly carved case, with extra fine Swiss 6 [illegible], shock-proof and weather-proof. Tested and adjusted for accurate timekeeping. Regular $10.00 value. Radium dial and hands. Send No Money. Pay on Delivery. Fill in Coupon below.

$3.59

Chain and Pistol Cigar Lighter Combination, sold separately would retail for over $15.00.

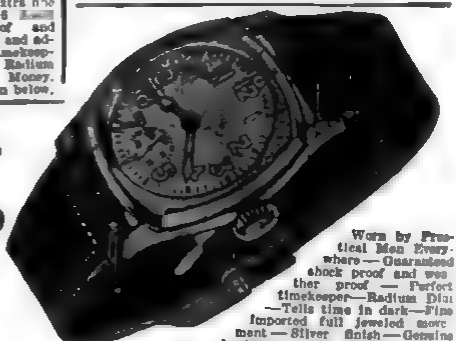
Here's an opportunity to buy this combination for only $3.59. Pocket Watch is an extra thin model —Beautifully engraved case, white gold finish—Handsomely designed dial with vision letters—*jeweled movement* and really a perfect timepiece. Comes to you with the latest style of *Waldemar chain and a fine gold plated knife*

The Cigar Lighter charm at the other end of the chain is a unique but practical cigar lighter and will delight you because of its oddness and of its usefulness. Order this $15.00 combination today at the Bargain Price of $3.59.

SEND NO MONEY

Pay on delivery. Fill coupon

Lifetime Precision Men's Strap Watch $3.99



Worn by Practical Men Everywhere—Guaranteed shock proof and weather proof — Perfect timekeeper—Radium Dial—Tells time in dark—Fine imported full jeweled movement—Silver finish—Genuine leather strap—Absolutely a $10.00 value. Fully guaranteed to give you complete and entire satisfaction. [illegible] is not a cheaply constructed domestic watch, but a real timepiece. [illegible] No Money. Pay on Delivery. Fill in coupon.

Tear off this COUPON and mail

The Jenking Corporation, Dept. 276-P-12,
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Gentlemen: Kindly ship me C. O. D. the following advertised articles (Check articles desired!):

—New Style Wrist Watch.....$3.99
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If You Pledge Yourself To Secrecy I'll Teach You

Dr. Harlan Tarbell
Master of Magic who has mystified magicians as well as laymen with his marvelous tricks.

Secrets of Magic!

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Baffling secrets of the world's greatest magicians—mysteries never before divulged—supernatural effects of the Orient—massive stage illusions—the most priceless, most treasured Secrets of the Magic Profession now—*for the first time*—disclosed to YOU in the great Tarbell Course in Magic. Learn to perform like a real magician in a short time—in your spare time—at home. Be the life of every party—the center of every crowd, wherever you go. Business and Social Success are YOURS when you know Magic. And it's EASY with the Tarbell System!

Earn $250 to $1000 a Month!

There is a tremendous demand for Magic Entertainment. Clubs, churches, schools, conventions, theaters are on the lookout for Magicians—pay $25 to $100 for perhaps half an hour's program. Keep your job. Make EXTRA MONEY on the side. Salesmen—business men—professional men—all can use Magic to gain popularity and profits. Easy for YOU to make $250 to $1000 [redacted]!

Astonish Your Friends Study the first lesson and your friends will be amazed at your wonderful Magical powers. You will have that Magnetic power that gives you instant popularity in any crowd. Everyone will marvel at your apparently supernatural, psychic power. YOU possess this talent now! Surprisingly *easy* to bring it out. Send the coupon below now—find out how easily you can do it.

Send for Big Free Magic Book

Write! Mail coupon now for big free Magic Book telling all about the great Tarbell Course in Magic. Find [redacted] how you can learn to be a real magician—easily and quickly!—at home!—by mail! Learn what I have done for others—people just like yourself. *Get our Prices and Easy Payment Plan. Mail coupon NOW!*

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Tarbell System, Inc., Studio 23-99
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Please send me your big FREE illustrated and colored booklet giving full information on the Tarbell System of Magic. No obligation on my part whatever.

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City and State .....

Modern Mechanics Goes Over the Top

LETTERS of commendation have been pouring in on the Editors so rapidly since the first issue of Modern Mechanics went on sale that even we, who knew the appeal a magazine of this type would have to active-minded folks throughout the country, were just a little overwhelmed—and mighty grateful too!—for the pats on the back and the constructive suggestions that attended the production of the first issue of the magazine. We are all the more "on our toes" to make each issue of Modern Mechanics better than the one before it, and looking at the great list of articles on airplane design, "how to build," and other features, that we have *lined up for future issues*, we are confident that readers will agree with us that the magazine fills a definite niche in the publishing field occupied by no other periodical!

The article on "How to Build Your Own Airplane," by T. W. Hodgdon, proved a special favorite with readers of the November issue. Two typical letters concerning Mr. Hodgdon's article are quoted below:

> Can you give me more working data on the small plane described in November Modern Mechanics, such as length, material for wing struts, width of fuselage, size of metal fittings, etc? Also will you please tell me at what price I can obtain the first 5 issues of Modern Mechanics?
>
> Clinton, Indiana. Firman S. Cooper.

> In your next issue I would suggest that you put in the name and address of the company which manufactures the small wire wheels used on the Smith Motor Wheel autos. These wheels, if I remember rightly, have a tread of about three inches and might be used on a small plane. You neglected to tell us how far apart we should place these wheels on the landing gear, for a monoplane or a biplane.
>
> Could you give me the address of someone in New York City who is making a light plane?
>
> 197 Nichols Ave.
> Brooklyn, N. Y. William Gersiek.

We have written both these contributors, answering their questions and explaining that Mr. Hodgdon's article was preliminary to a complete series in this magazine which will give full details on various models in future issues. January will carry plans for the Heath Super-Parasol Sportplane, a remarkably efficient steel tube light airplane.

Another letter comes from an Iowa reader and contributor:

> Got the November issue of Modern Mechanics and read it thoroughly. The articles on Submarine rescue and Garage "Gyps" were mighty pleasing. Guess no matter how well a fellow knows his onions about a car, someone else knows 'em better and cashes in on the information.
>
> Missouri Valley, Iowa Frank Bentley.

We think Mr. Bentley's remarks about the Auto "Gyp" article are well taken. It is part of the purpose of this magazine to give its readers authentic information which will enable them to protect their best interests if they should ever encounter crooks of the type exposed in Mr. Voorhee's article.

The author of the article on the Photomaton machine, which was a popular feature of the November issue, sends us the following chatty note:

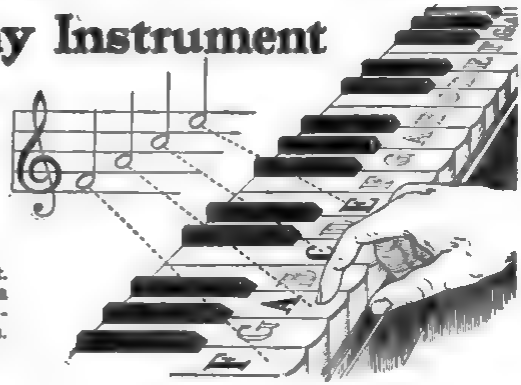
> Have just got November Modern Mechanics after trying to find it on fully a dozen newsstands. Same trouble everywhere—the books sold so quickly that most dealers were cleaned out the first day. You should have doubled your press run. Modern Mechanics is a very creditable magazine, obviously gotten out by past masters in the game. I like the subtitle idea, introducing the article in its most striking phases.
>
> 139 Payson Ave.
> New York City Orville H. Kneen.

The Editors cordially hope that readers will continue to send them letters of suggestion or criticism, especially those suggesting subjects they think would make interesting articles. We are trying to make this magazine *your* magazine, and will be grateful if you will continue to help us.

—The Editors

Easy as A–B–C !

You Can Play Any Instrument In a Few Months This Delightful New Easy Way!



Quickest because natural and pleasant. Grateful students say they learn in a fraction of the time old dull methods required. You play direct from the notes. And the cost averages only a few cents a lesson!

LEARNING music is no longer a difficult task. If you can read the alphabet, you can now quickly learn to play your favorite instrument! A delightful new method has made it positively easy to become a capable performer within just a few months. And the cost is only a *fraction* of what people used to spend on the old, slow methods!

You don't need a private teacher, this new way. You study entirely at home, in the privacy of your own room, with no one to interrupt or embarrass you. And, strange as it may seem, you'll enjoy every minute of it—because the new method is *agreeable* as well as *rapid!*

No Tricks or Stunts—You Learn from "Regular" Music

You don't have to know the first thing about music in order to begin. You learn to play from actual notes, just like the best musicians do. And almost before you realize your progress, you begin playing real tunes and melodies instead of just scales. There are no trick "numbers," no "memory stunts." When you finish the U. S. School of Music course, you can pick up any piece of regular printed music and understand it! You'll be able to read music, popular and classic, and play it from the notes. You'll acquire a lifelong ability to please your friends, amuse yourself, and, if you like, make money (musicians are highly paid for their pleasant work).

Whether you like the piano, violin, 'cello, organ, saxophone, or any other instrument, you can now learn to play it in an amazingly short time. By means of this wonderful newly perfected method reading and playing music is made almost as simple as reading aloud from a book. You simply can't go wrong. First, you are *told* how a thing is done, then a picture *shows* you how, then you do it yourself and *hear* it. No private teacher could make it any clearer. The lessons come to you by mail at regular intervals. They consist of complete printed instructions, diagrams, all the music you need, and music paper for writing out test exercises. And if anything comes up which is not *entirely plain*, you can write to your instructor and get a full, prompt, personal reply!

The Surest Way to Be Popular and Have a Good Time

Do you sit "on the sidelines" at a party? Are you out of it because you can't play? Many, many people are! It's the musician who claims attention. If you play, you are always in demand. Many invitations come to you. Amateur orchestras offer you wonderful afternoons and evenings. And you meet the kind of people you have always wanted to know. So don't miss this exceptional opportunity.

Learn to Play by Note

Piano	Saxophone
Organ	'Cello
Violin	Sight Singing
Drums and Traps	Guitar
Banjo (Plectrum 5-String, or Tenor)	Ukulele
	Hawaiian Steel Guitar
Mandolin	Harp
Clarinet	Cornet
Flute	Piccolo
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Voice and Speech Culture
Automatic Finger Control
Piano Accordion

Free Book and Demonstration Lesson

The whole interesting story about the U. S. School course can not be told on this page. So a booklet has been printed—"Music Lessons in Your Own Home." You can have a copy absolutely free by mailing the coupon below. In the booklet you will find an offer that makes the U. S. course available to you at a very low price. With it will be sent a Free Demonstration Lesson which shows better than words how delightfully quick and easy this wonderful Method is. If you are really anxious to become a good player on your favorite instrument, mail the coupon now—today. Instruments supplied when needed, cash or credit. **U. S. School of Music, 28212 Brunswick Bldg., New York City.**

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Neglect of Home-Study Training Cost This Man $47,424!

How much are you paying to stay untrained?

Some time ago we received a letter which every man working for a living ought to read—whether he's making $20 a week or $200. Here it is:

"During the forty years that I have been working, my salary has averaged less than twenty-four dollars per week with the exception of the last two years while I have been acting as foreman. I made good in this position and saw, through the failings of others, what would happen to me unless I found a way to train for larger responsibilities.

"I had read of correspondence courses and began searching for one I thought would benefit me. I found it in the LaSalle Modern Foremanship course, and benefited by it, my salary being nearly doubled, and I was promoted from foreman to factory superintendent.

"This happened in a period of about ten months, and by devoting only about four or five hours per week to the studies.

"I am now enrolled as a member of the Industrial Management course, and find the work very interesting and beneficial. It can be applied every day in the factory, and brings results.

"I regret that I put it off to so late a day in life to reap the benefits I am now enjoying, and can truthfully say to younger men that if they would only profit by the experience of others they can gain more knowledge through one year's training by LaSalle methods than can be obtained in ten years' practical experience by hard work."

We quote the above letter not because the man who wrote it is making a staggering salary as a result of his training, but because it illustrates so clearly the principle behind LaSalle training.

Here is a man who all his life had accepted the thought that he was compelled to work for little or nothing.

For one thousand, nine hundred and seventy-six weeks the writer of this letter *paid at least $24 a week for the doubtful privilege of staying in the ranks of untrained men.*

Can anyone doubt that training would have doubled his salary just as easily when he was thirty-eight years younger—when he could attack his work with the abundant energy of a younger man?

Yet his neglect of this main avenue of progress cost him—leaving simple and compound interest out of the reckoning—the appalling sum of $47,424—a fortune in itself.

If You Could Use $47,424, Pause Before You Turn This Page

Perhaps you are already making quite as much as the writer of that letter—perhaps more. Perhaps, on that account, you may think that his experience does not apply to YOU.

But if training in Higher Accountancy—or Modern Salesmanship—or Business Management—or Law—or Business Correspondence—or any of a dozen other branches of business could change your forty-eight dollars into no more than $72 a week (which is easily possible) and if you now NEGLECT to advance yourself—will you not find it difficult, thirty-eight years from now, to explain to those who are dear to you why you threw away $47,424?

We're not going to moralize. We're not even going to cite any of the thousands of letters from men who have not merely increased but doubled and tripled their incomes through home-study training under the LaSalle Problem Method. We *have* the letters. We will *show* them to you, if you like. But understand, please, that they would not *alter* the facts—they would merely *emphasize* them.

Below this text there's a coupon. It will bring you not only full details of the training that appeals to you, but also a copy of that most inspiring book, "Ten Years Promotion in One."

If you are sincere in your desire for advancement, you will not turn this page until you have clipped the coupon, filled it in, and by placing it in the nearest mail box placed *yourself* on the road to real success.

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The World's Largest Business Training Institution

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30 UP-TO-DATE SELECTIONS

With this Portable Phonograph

$1.00 DOWN

Sensational offer. A special assortment of up-to-date high-grade new electric process 75c records—30 selections in all, 15 double face records—very latest selections, popular songs, dance music, band and instrumental pieces. $11.25 worth of brand new records included with this outfit. And we've picked out just the kind of records to please you most. Read our wonderful offer below.

30 Days Trial Yes, we will send this Puritone portable phonograph outfit, with 30 high grade selections, 15 double face 75c records to your home on 30 days trial for only $1.00 with the coupon. Use it as your own and see what a wonderful convenience it is to have a phonograph that you can carry from room to room. Use the outfit on 30 days trial. If within 30 days you decide not to keep [illegible] we'll refund [illegible] all transportation charges.

$2.00 a month If you keep it, pay only $2.60 a month until you have paid—only $26.85. Think of it, a first-class high grade phonograph, and 15 high grade up-to-date double face records—(30 selections) a complete outfit, ready to play, only $26.85.

This Portable Phonograph plays any make of 10-inch disc records and plays two ten-inch records with one winding. Weighs only 17 pounds. Comes in waterproof imitation leather case with hinged lid, closes up like a small suitcase with snap locks and carrying handle (see illustration.) Measures 14½ x 12 x 7½ inches. Records are placed inside of lid and secured so they will not rattle or break. Holds ■ records. Has quiet spring motor, tone arm and reproducer with indestructible diaphragm and wide throat for full sound volume. Outfit includes 15 double face 75c *New Electric Process* records—30 selections. A complete record library without buying a single one! Shpg. weight, packed about 25 lbs.

Order by No. W8264A; only $1.00 with coupon, $2.00 monthly Total price $26.85.

Send Coupon Now

Seize this opportunity on this special sale, while it lasts. Only $1.00 with the coupon brings the complete outfit on 30 days trial.

FREE CATALOG *of home furnishings sent with or without coupon. See coupon.*

Straus & Schram, Dept. 4739 CHICAGO, ILL.

[illegible] Schram, Dept. 4739 Chicago, Ill.

Enclosed find $1.00. Ship special advertised Puritone Portable Phonograph with 15 Double Face 75c *New Electric Process* records—30 selections. I am to have 30 days free trial. If I keep the outfit, I will pay you $2.00 monthly. If not satisfied, I am to return the phonograph and records within 30 days and you are to refund my dollar and express charges I paid.

Puritone Portable Phonograph and 15 Double Face Records, W8264A, $26.85

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Married or Single? ..... Nationality or Color .....

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Thank You for Mentioning Modern Mechanics When Writing to Advertisers

Gangland Uses Latest Guns to Battle Police

Thompson sub-machine guns, latest advancement of the gun-makers' art, are used by gangsters in waging their endless warfare against the police and against themselves. See "Gangland's Death Machines" on page 46 of this issue.

Edited by EXPERTS

MODERN MECHANICS Magazine is edited by experts!

Because the publishers of Modern Mechanics have picked the best known men from every field related to things mechanical, and have retained them to write on their various subjects, Modern Mechanics is like no other mechanical Magazine.

Each department is edited by a man who is at the top of the heap in his profession. All matter published in the magazine has had the surveillance of these men. They have passed on all that is presented to you.

Who are they?

Major H. H. Arnold was assistant chief of the American Air Service during the World War. Major Arnold is an active flying officer, and author of "Airmen and Aircraft" as well as a number of other popular works on the subject "Plane Talk" which he conducts for Modern Mechanics.

A. Neely Hall, author of the "Boy Craftsman" and numerous other boys' books, builds things which are of absorbing interest each month and tells about them in the "Boys' Workbench" Department. Mr. Hall has a splendid shop and study of his own where all the interesting things published in his department are planned out and built.

Gene Shank, premier commercial pilot of the Northwest and youthful holder of the Loop the Loop Record, owns and operates a splendidly equipped airport and advanced air school at Minneapolis. Shank is in the air from one end of the day to the other, and knows an airplane inside out! When aerial acrobatics are called for, the country calls on Gene to put on the show, —and how he does! Shank is telling our readers how to fly.

Charles Magee Adams, one of the outstanding radio authorities of the day is also an experimenter with a knowledge gained from following radio from its infancy. He has gained at first hand the inside information on the wrinkles and radio kinks he gathers each month for "Sparks from the Radio Editor."

If home movie making is your hobby, Walter D. Kerst can answer your problems! Mr. Kerst, who edits "The Amateur Camera Man" department, is editor of The Movie Makers Magazine, and has been in touch with the amateur movie fad ever since its inception.

IN THE automotive field, no one is better known as a writer and an authority on the developments of the auto than Ray F. Kuns, who has charge of "Motor Mechanics" department. Mr. Kuns is editor of Automobile Digest and is probably in closer touch with the automobile industry than any other man in America.

Percival Marshall is England's great exponent of Model Making. The famous British Model Engineer is edited by Mr. Marshall, and readers of Modern Mechanics are put immediately in touch with the absorbingly interesting developments with which Mr Marshall is in touch months before they become known to the general public.

Chief of Staff is Weston Farmer, naval architect, an engineer nationally known for his speedy hydroplane and motorboat designs. Mr. Farmer has built and flown several light planes himself and is an authority on design and construction of light planes as well as yachts. And so it is with all the branches of learning which deal with mechanics—editors are being carefully selected in all parts of the world who are recognized experts in the field they cover, so that readers of Modern Mechanics are assured of the authenticity and freshness of all matter presented. If you see it in Modern Mechanics, you can believe it—it has been edited by experts!

Articles in Modern Mechanics are Authoritative!

What Will Byrd Find

By G. H. DACY

Sheer icewalls, a hundred and fifty feet high, constitute an impassable barrier for hundreds of miles along the South Pole ice cap, preventing explorers from landing except in the Bay of Whales, where Commander Byrd will establish a base. Photo from Capt. Hurley.

MYSTERY has enshrouded the continent of Antarctica since its earliest discovery. Hardy explorers have visited the South Pole, but no man has ever set foot in the vast wilderness of ice to the east of it—an area as large as the United States. What is Commander Byrd likely to find there?

Static meter

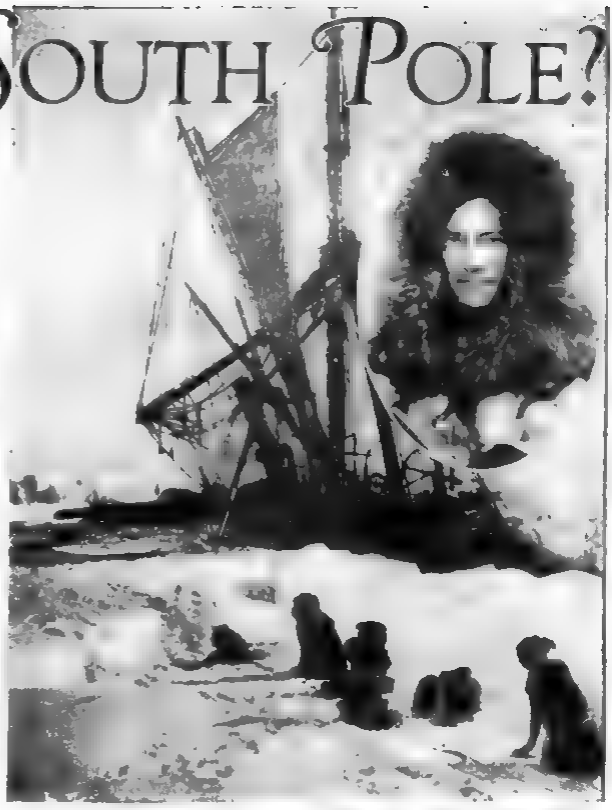
WHAT is the purpose of the Byrd Antarctic Expedition? What does Commander Byrd, one of the greatest of present-day explorers, expect to find in the bleakest spot in the world, where the temperature constantly hovers around 80 degrees below, and where five-sixths of the permanent ice supply of the earth is locked?

Commander Byrd's purpose is simply explained. The Expedition was organized for scientific research. Yet in so describing it, much is left unsaid. The long months of preparation, the building of marvelously precise instruments for recording the whimsies of Nature at the bottom of the world, the assembling of men, ships, airplanes, food and supplies—all this was but the preliminary labor of establishing an outpost of science on the Antarctic continent.

No one can foretell what Byrd will find in Antarctica. Previous explorers have reported vast coal deposits. The mountains of the South Polar land may very well contain limitless wealth in the form of gold, silver, and other ores. There may be vast oil pools under the immense ice-cap, for the continent is comparable in size to North America. No man knows what secrets the South Pole holds locked in its icy grip; no man of our generation is likely to know all of them.

Scott and Amundsen and Shackleton, however, have reported certain features of the

At the SOUTH POLE?



—Byrd Photo from Times-Wide World.

Commander Richard Byrd (inset) goes to a continent of ice which has defied explorers for centuries with its vast protective wall of moving ice. One of the most dramatic episodes in the history of polar exploration is pictured above by Capt. Hurley, photographer with the Shackelton and Mawson expedition to the South Pole. Their ship, the Endurance, drifted for five months locked in the ice pack, and finally was crushed to pieces. The men drifted on the ice floe, and four expeditions tried to reach them before they were rescued. Will Byrd's ships suffer the same fate?

Antarctic continent which Byrd is certain to encounter. The edge of the continent is protected by a forbidding ice barrier presenting a sheer unscalable front extending for miles without a break. From this ice-cap huge bergs break off to float the seas, sometimes attaining the incredible length of 50 miles—15 miles wider than the State of Rhode Island!

Antarctica is the world's last great geographical riddle which Byrd and his companions expect to solve. The expedition will use pilot balloons carrying weather detectors to study the Polar atmosphere. Puzzles of Antarctic geology, oceanography, geography, cyclone origin, blizzards, mineralogy, the nature of the aurora australis (southern lights), the formation of the world's largest icebergs, magnetic declination—all of these will be investigated by Byrd's trained scientists.

Byrd's flight over the South Pole will be probably the severest test to which an airplane has ever been subjected. Terrific wind storms rage almost constantly, attaining velocities commonly as great as 100 miles an hour. Then there is the problem of taking off at high altitudes—the Antarctic plateau is 10,500 feet above sea level. The large three-motored Ford plane and the three smaller scout planes Byrd is taking with him, are especially designed to combat these conditions.

The airplanes of the expedition were carefully selected. In the first place, planes with low landing speeds were necessary, because in the Antarctic the land is criss-crossed with hillocks of ice and snow, some of them hundreds of feet high. These hills cannot be distinguished from flat land in the air. An airplane in landing must come down slowly in order to avoid such obstructions; planes with high landing speeds would be likely to crash, killing all their occupants.

Dog Teams for Safety

For the flight across the South Pole, the Ford tri-motor plane will be used. On such

a dangerous flight a multi-motored plane is a necessity in order to minimize the danger of a forced landing. As an illustration of how Commander Byrd leaves nothing to chance, it might be mentioned that the plane in which he flies over the Pole will contain six dogs, an umbrella tent, and sleds for use in walking back to the base camp in case the airplane should be forced to the ice.

"Be prepared" is the watchword of the Expedition. The Byrd party is the best equipped of all those expeditions which have penetrated to the far southland. There are 1,200 different items of equipment, including special wooden houses with special Polar ventilators, fur garments from Alaska with Eskimo tailors to care for them, footwear to prevent frozen feet, skis from Norway, climbing ropes, ice axes, alpinstocks and ski-poles from Switzerland, 200 tons of food, and an endless variety of other articles.

In case the party gets into dangerous straits, it must be self-rescuing, for it is manifestly impossible for a relief expedition to be organized as was the case in the recent crash of the *Italia*. The South Pole is too far away from civilization for rescue parties to reach it in time to be of any value, and even if they did reach the continent in time, they would be helpless to aid explorers in the far hinterland.

Consequently Commander Byrd has equipped the Expedition with a hundred "blizzard" dogs. The peculiarity of a blizzard dog is that he is able to find his way back home in a raging blizzard when a man's sense of direction is hopelessly lost. Under ordinary circumstances a blizzard dog seems no different from the common Arctic huskie, but in time of peril he becomes the best friend of lost explorers.

WILL BYRD SOLVE THESE SOUTH POLAR MYSTERIES?

Is the Antarctic one continent or two great islands?
Explorers differ on this question.

How deep is the ice covering?
Instruments will disclose this secret.

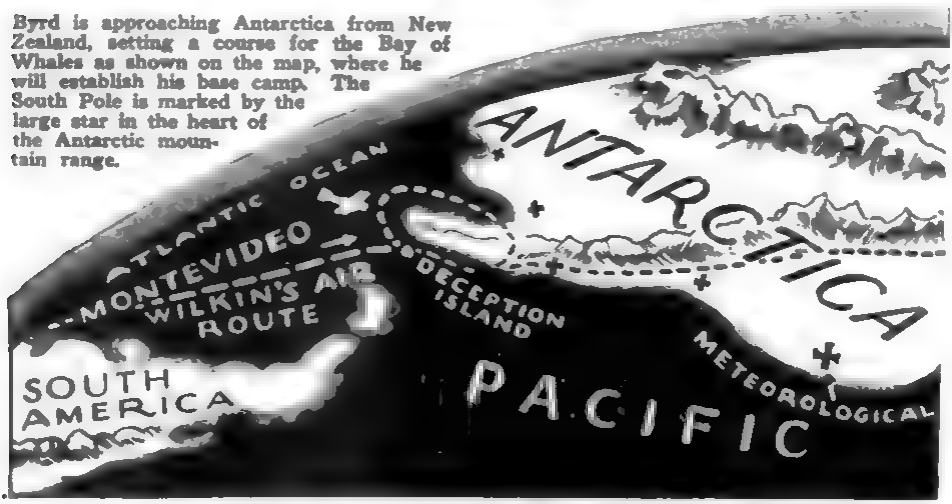
What lies beyond the South Pole?
With airplanes, Byrd can go beyond, where Scott, Amundsen, Mawson and Shackelton could not.
The pole has never been approached from the side opposite Ross sea.

Is the polar mountain range a continuation of the Andes?
One of the greatest geographical mysteries to be solved.

What life existed in the unexplored interior before the Ice Age?
Fossils and rocks may disclose these secrets.

Measuring Ice 1,000 Feet Deep

To ascertain the depths of the general continental ice cap, estimated to average 1,000 feet in thickness, a small sonic depth finder similar to that originated in the U. S. Navy will be used. This device measures depth in ice or water by timing the sound of an ex-



Byrd is approaching Antarctica from New Zealand, setting a course for the Bay of Whales as shown on the map, where he will establish his base camp. The South Pole is marked by the large star in the heart of the Antarctic mountain range.

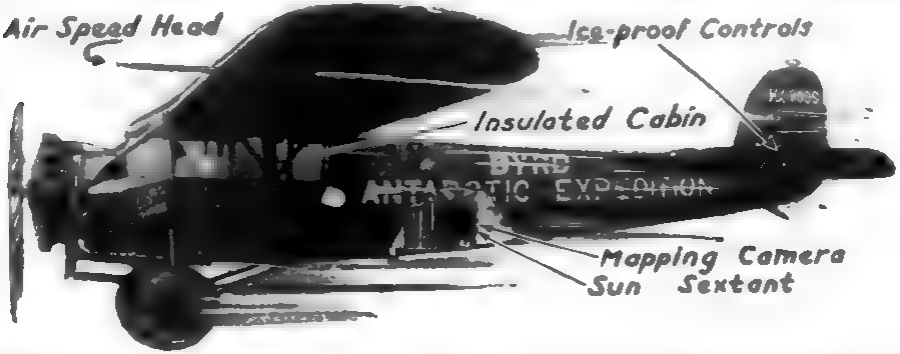
ploded cartridge. The sound waves travel through the ice and are reflected back again to the recorder. The time required for the echo's return gives accurate data for measuring the distance traveled.

Physicists of the Expedition are equipped with delicate instruments loaned for the purpose by the Terrestrial Magnetism Division of the Carnegie Institute. An electrograph will be set up at the expedition's base to make continuous photographic records of variations in atmospheric electric pressure. A battery of variometers linked to a special camera will keep a record of shifting magnetic direction between the true and magnetic poles as well as the vertical and horizontal intensity of the earth's magnetic field.

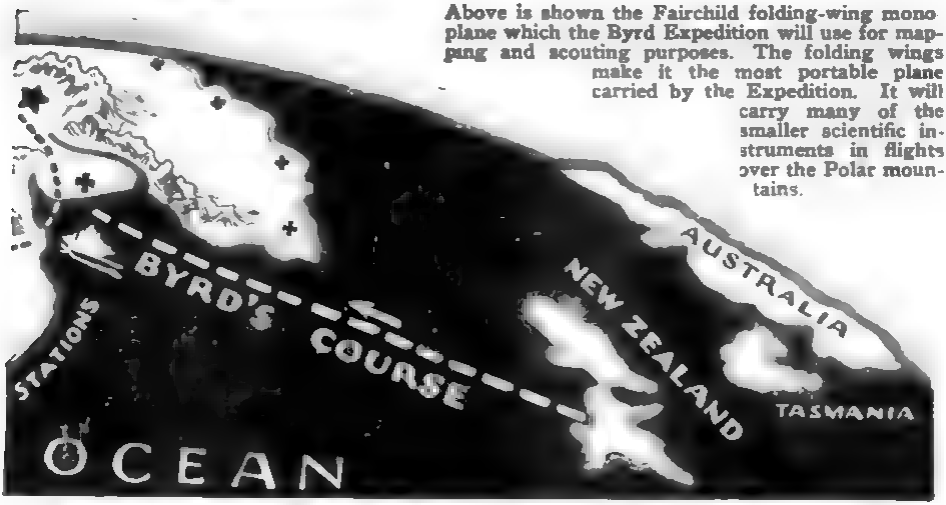
Spectroscopic studies of the aurora australis will be made. Other instruments will study how the atmosphere conducts electricity. Resultant data will help to solve the mystery of electromagnetic storms, which are accompanied by polar lights and cause electric disturbances powerful enough to disrupt cable and telegraphic communication.

The Ice-Chest of the World

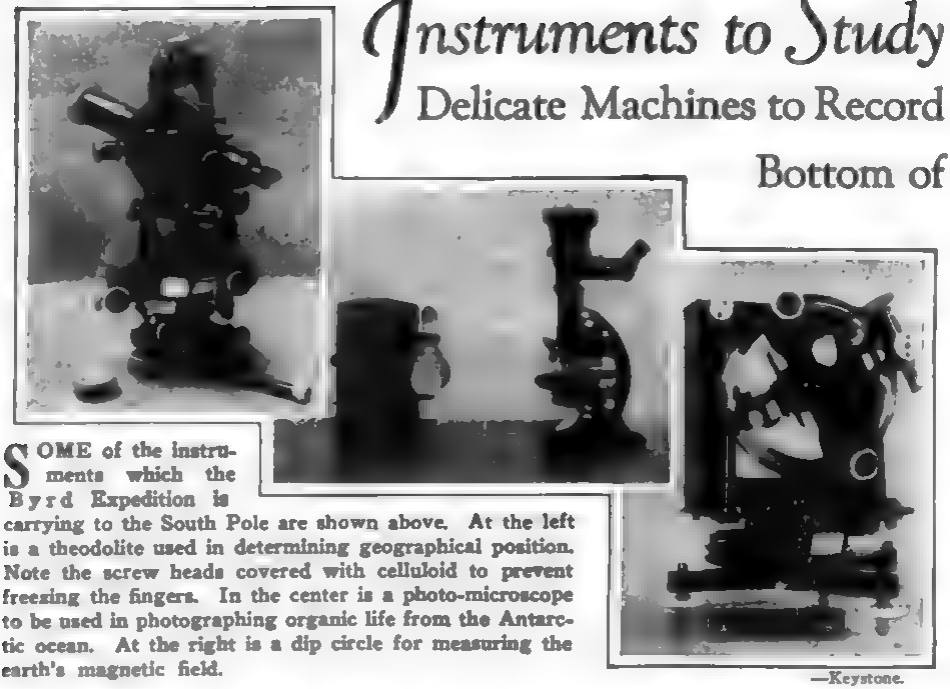
Photographs of the Antarctic mountains will give the world pictured records of the curious geological formations existent in that little known land. Only the polar highlands can be mapped by airplane, for the lowlands are covered with impenetrable ice. Whether or not this ice sheet will ever recede is a question on which Byrd may be able to throw some light. The ice cap now covers 5,000,000 square miles. In the Pleistocene age of geology the world's permanent ice supply covered 12,000,000 square miles. Much of this was represented in the glaciers



Above is shown the Fairchild folding-wing monoplane which the Byrd Expedition will use for mapping and scouting purposes. The folding wings make it the most portable plane carried by the Expedition. It will carry many of the smaller scientific instruments in flights over the Polar mountains.



Instruments to Study Delicate Machines to Record Bottom of



SOME of the instruments which the Byrd Expedition is carrying to the South Pole are shown above. At the left is a theodolite used in determining geographical position. Note the screw heads covered with celluloid to prevent freezing the fingers. In the center is a photo-microscope to be used in photographing organic life from the Antarctic ocean. At the right is a dip circle for measuring the earth's magnetic field.

—Keystone.

which descended on North America and Europe. These glaciers disappeared ages ago, and it is entirely possible that the South Polar ice is gradually melting away. The process, however is so slow that science has not been able to detect it.

Two large volcanoes, still active, are known to exist near the South Pole. They were named Mt. Erebus and Terror Mountain. Mt. Erebus was climbed in 1912 by members of Scott's party. The Byrd expedition will study these volcanoes and learn if they differ in any respects from erupting volcanoes in more temperate climates. The fact that these volcanoes exist indicates that fires burn just as hotly under the frozen pole as in warmer parts of the globe.

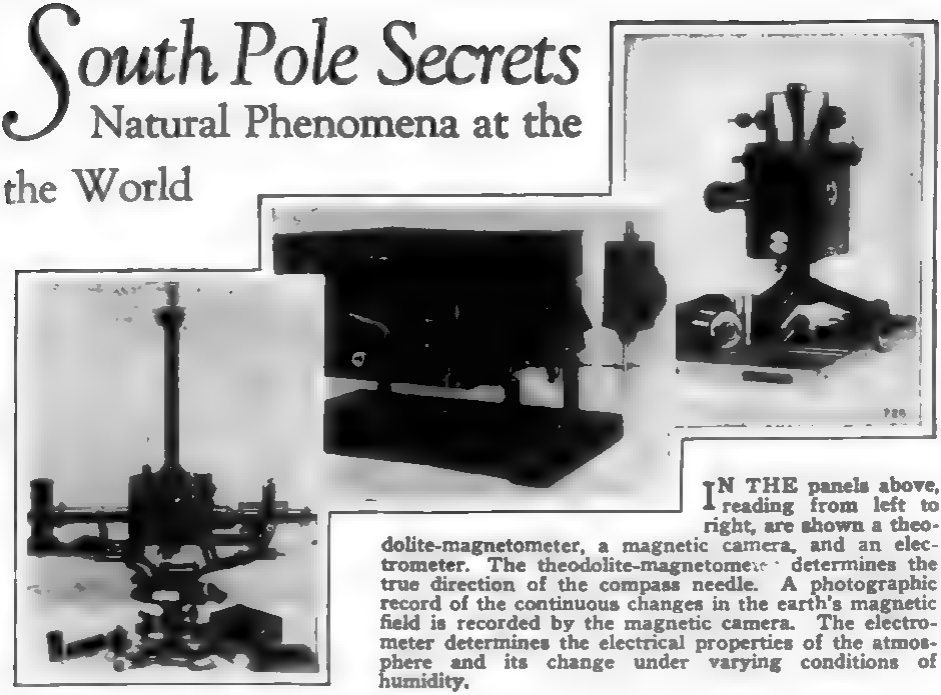
Weather phenomena will be the object of intensive study. At about latitude 60 degrees, which skirts the Antarctic region, there occurs a low pressure weather belt. North of that area the wind blows from the west, while south of it dominant east winds prevail. This violent opposite movement of air breeds cyclones. The expedition hopes to collect information which will enable weather experts of the future to predict cyclones several months in advance of their actual occurrence.

Re-Making the Map

Maps of the Antarctic now published are accurate in spots, but they also contain much scientific guesswork. More than two-thirds of Antarctica is unexplored and unmapped territory. Commander Byrd's systematic sounding of the sea floor along the coasts, may disclose oceanic islands which are now unknown. Changes in the contour of the sea bottom usually indicate the proximity of islands.

Coal is the carbonized remains of ancient forests, and the fact that coal deposits have been found in Antarctica indicates that at one time the continent was free from ice. Geologic changes similar to those which raised what is now Florida from the ocean bottom have submerged large areas of the Antarctic continent. Certain similarities between the South American mountains and ex-

South Pole Secrets
Natural Phenomena at the the World



IN THE panels above, reading from left to right, are shown a theodolite-magnetometer, a magnetic camera, and an electrometer. The theodolite-magnetometer determines the true direction of the compass needle. A photographic record of the continuous changes in the earth's magnetic field is recorded by the magnetic camera. The electrometer determines the electrical properties of the atmosphere and its change under varying conditions of humidity.

posed portions of the Antarctic have led to the belief that the two were once connected. There is also a general belief that an arm of the sea separates East and West Antarctica. Byrd's airplane flights will help to solve these disputed points.

Animal life does not exist near the South Pole, though seals, penguins, and sea elephants inhabit the neighboring [illegible]. Plant life also is very limited. Algae, mosses and scraggly lichens are the only plants that occur. In the course of oceanic investigations water samples from South Polar seas will be collected and analyzed.

What types of bacteria exist in Antarctica and what extremes of temperature can they withstand? What causes the curious combination of warm and cold water areas in South Polar seas? Explorers have reported tropical water temperatures even in that land of ice. Will the Antarctic ever be developed as a source of power by harnessing the mighty winds that blow there constantly? Was Antarctica once linked with South America?

When the Byrd expedition returns to New York in 1930, it will probably bring with it the answer to all these questions.

"We have prepared ourselves as thoroughly as we knew how," is Commander Byrd's final word on embarking for the long journey to New Zealand. "The success of the Expedition now is on the lap of the gods." The good will of science rides with him!

BYRD ON THE FUTURE OF AVIATION

THOUGH I look for no immediate spectacular advance in flying, I do believe that design will be slowly improved, performance enlarged, and safety increased every year. Commercial planes now usually work at speeds of from 60 to 90 miles an hour. In a year these limits should be from 110 to 150 miles an hour. Probably 200 miles an hour will be the limit in a few years.

I think the so-called "flivver", or small private plane, is practical today and will soon be built in quantities at a cost of from $1000 to $2000. The popular size will carry 2 or 3 passengers and be built for safety rather than for speed.

—Commander Richard E. Byrd.

What Byrd's Plane Will Look Like Over the Pole

THIS photograph of one of the Byrd Expedition airplanes shows the view a photographer would get if he were stationed at the South Pole when the plane passed over it. Note the substitution of grooved skis for the conventional wheels of the landing gear. In Polar exploration work various types of skis are used according to the weather conditions. Broad skis are used for landing in soft snow; narrower skis are used when ice or crusted snow is encountered.

The plane shown is a Bellanca monoplane to be used in scout work for the Expedition.

The runners on the bottom of the skis are to prevent the plane's skidding on smooth ice.

Note the special struts on this airplane, designed so that they act like wings in helping to keep the plane in the air.

PRIZES *for* IDEAS

WHAT are the latest scientific developments that you would like to see illustrated on the cover of Modern Mechanics Magazine? Perhaps *you* have an idea that can be worked up by our staff artists into a suitable cover painting. For the best cover suggestions received before January 1, 1929, $50 in prizes will be awarded, as follows: First prize, $25; second prize, $15; third prize, $10.

It is not necessary to sketch out your idea unless you wish to; a clearly written description will be sufficient. Unusual inventions in the field of aviation are suggested as being particularly effective for cover use, but there is no limitation imposed on your choice of subjects except that they must be striking and unusual from a mechanical angle. Address your suggestions to Modern Mechanics Magazine, Robbinsdale, Minn.—and remember that if your idea is good you have an excellent chance of winning the first prize!

After you have sent us your cover idea, why not try your luck in the other prize contests Modern Mechanics is conducting? Photographs showing New Uses for Old Fords are paid for at $10 each, as announced on page 119. Five dollars is offered for prize-winning snapshots—see page 177. Then there is the Coo-Coo Contraptions Contest with its offer of $50 in prizes, and the Model Boat Contest with $50 in prizes and a handsome trophy cup! Coo-Coo Contraptions rules are printed on page 96; the Model Boat Contest is announced on page 159. Get into the game and make sure of getting your share of the prize money!

Professional Safe Cracker is Friend to Banker

SAFE cracking is the profession of George Bloom of Oakland, Cal., but his operations are entirely legitimate. He is employed by banks and business men to open safes when nobody else can.

Years ago, when safes were not so well built, Bloom could put his ear to the safe door, whirl the dial, and solve the combination a la Jimmy Valentine. But today's locks operate so silently that Bloom was forced to invent his own safe cracking apparatus, which is a combination radio set and detectaphone, with dry cells, transformer and vacuum tubes connected up to amplify minute sounds.

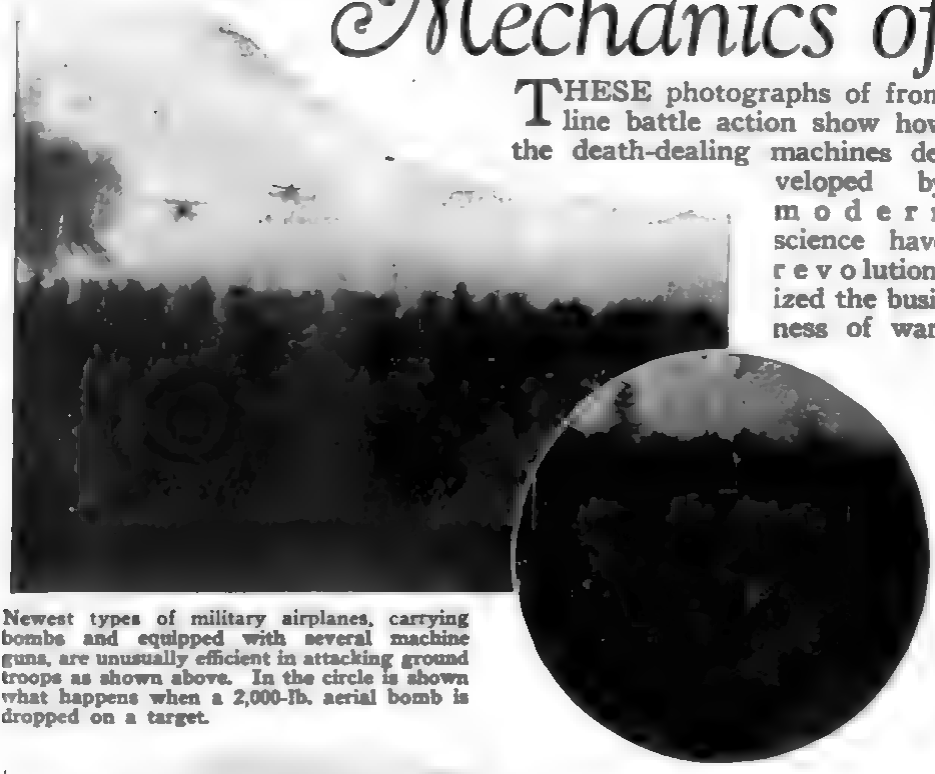
In demonstrating the effectiveness of his invention, Bloom locked a small clock inside a strong box, as shown in the photograph, and closed the steel door. By holding the detectaphone against the outside of the safe, the ticking of the clock could be heard through two and a half inches of solid steel. Bloom works out combinations by listening to the fall of the tumblers with his device.

Tiny Kettle Made by Hand from Copper Penny

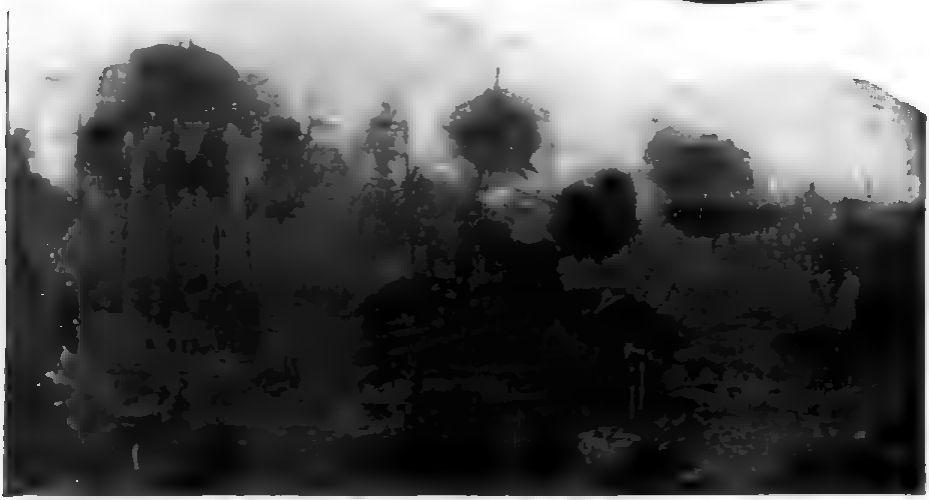
MONTHS of patient work were required in making a tiny model of a kettle out of a copper penny, the completed model being only half an inch in height. The feat was performed by a skilled workman of Hamburg, Germany. The photograph shows the kettle in its maker's hand, alongside a penny like the one from which it was made. Comparison of the kettle and penny with the ring on the man's finger will give a good idea of relative size. No soldering joints are visible on the kettle, which is an excellent piece of workmanship. The lid is removable and even the spout is hollow.

Mechanics of

THESE photographs of front line battle action show how the death-dealing machines developed by modern science have revolutionized the business of war.



Newest types of military airplanes, carrying bombs and equipped with several machine guns, are unusually efficient in attacking ground troops as shown above. In the circle is shown what happens when a 2,000-lb. aerial bomb is dropped on a target.



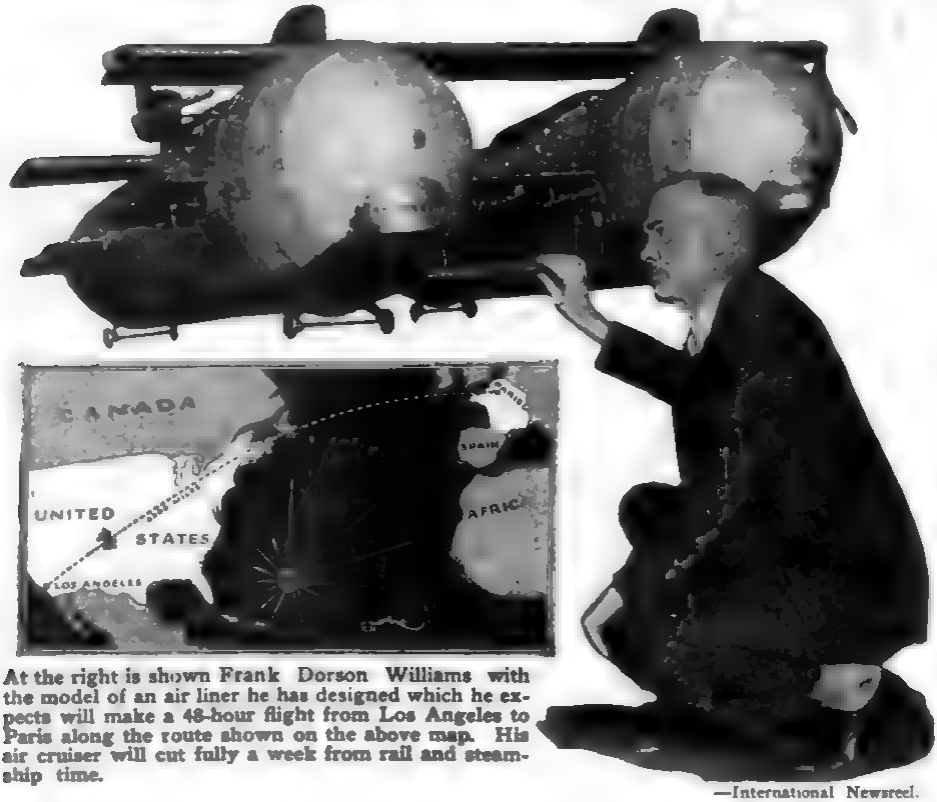
Tanks were invented during the World War, but since the Armistice these huge monsters of steel have been perfected so they are practically invulnerable to attack. The above photo shows how troops advance under protection of a tank.

WAR!

Desolation follows in the wake of aircraft which can drop gas bombs, as shown above, capable of destroying entire regiments. For an interesting prediction of what the military airplane of the future will be like, turn to Major H. H. Arnold's article on page 80 of this issue.

The battle photo shown above is a far cry from medieval days when wars were decided by the broadsword and cross-bow! Tanks, machine guns, automatic rifles, hand grenades, gas masks—all these devices of modern science help to make modern warfare a battle of machines.

Los Angeles to Paris Flight Planned for Air Cruiser



At the right is shown Frank Dorson Williams with the model of an air liner he has designed which he expects will make a 48-hour flight from Los Angeles to Paris along the route shown on the above map. His air cruiser will cut fully a week from rail and steamship time.

—International Newsreel.

A GIANT air liner which is expected to make the 6,300-mile flight from Los Angeles to Paris in 48 hours is now under construction in California. The aircraft is unusual in its design, being a combination dirigible and airplane.

Twin gas bags are joined together by airplane wings, and landing gear of the usual airplane type is built under the dirigible bodies. Each of the twin bags shown in the photograph will be 290 feet long and 80 feet in diameter. The wing spread of the completed cruiser will be 182 feet. It will carry 104 passengers and a crew of 14. It will cost $1,250,000 to build.

NURSE DESIGNS FLYING AUTO

—International Newsreel

AN AUTOMOBILE which can be turned at will into a boat or an airplane has been patented by Miss Elsie Tubbe, a Brooklyn nurse. The vehicle is intended mainly for road work, but is equipped with propeller and folding wings and a water-tight body. The airplane attachments are intended for use when rough or impassable roads are encountered, or where speed is necessary.

ENGINEERS TAP *Natural Steam* POCKETS

Underground fires are harnessed for electric power.

In this diagram the artist has shown how Mother Nature generates steam hundreds of feet beneath the surface of the earth. The insert shows live steam pouring through a steam-well drilled in Sonoma county, California. It is transformed into electric current.

STEAM generated in the hot underground regions of the earth is being harnessed for useful service by engineers working in the "Great Pressure Tank" of Sonoma county, California. The steam is directed into turbines which are harnessed to generators, producing electric current for commercial use.

Molten rock, heated by interior earth-fires, comes into contact with water which is continually trickling through the earth's crust. The hot fires transform the water into steam, which is confined in underground chambers until such time as it may be liberated through pipes.

Methods employed in drilling for steam are similar to those used in sinking oil wells. A 60-foot derrick is erected and an open hole is first drilled down into the rock for several yards and a 10-inch casing fitted inside it. The surrounding space is filled with concrete and the hole drilled farther until a good flow of steam is obtained.

World's Largest Telescope Mirror Nears Completion

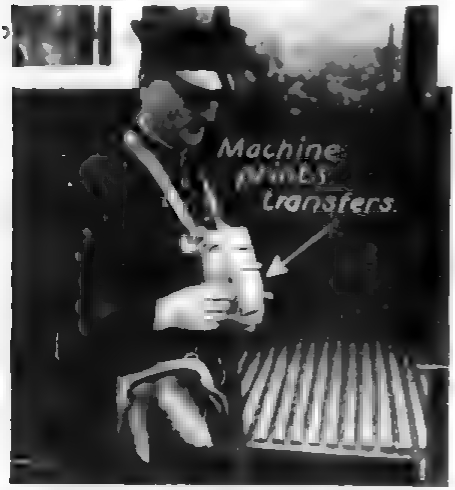
—International Newsreel

Here workmen are shown boring a hole through the huge telescope mirror.

SEVERAL months were required to cool the molten glass of the world's largest reflecting telescope lens, shown in the photograph. The cooling operation is prolonged in order to make certain that the huge mirror will be of the same density throughout its entire mass. If this precaution is not taken, a distorted, wavy effect will be produced in the glass similar to that frequently observed in cheap window panes. This huge lens is almost nine feet in diameter. It will be installed in the Parkins Observatory at Ohio Wesleyan University. Previously the largest telescope was the 100-inch reflector at Mt. Wilson Observatory.

CONDUCTORS CARRY TRANSFER PRINTING MACHINES

EACH street car rider in Berlin now gets a freshly printed transfer direct from a machine the conductor carries suspended from his shoulders. When a customer requests a transfer, the conductor sets the dials on his printing device to record the date and transfer point, and by turning a crank the transfer is ejected from a slot in the machine. Each transfer is automatically numbered.



This street car conductor carries a complete machine for printing transfers. Note the satchel in which he keeps his change.

LEAPING BOAT GIVES THRILL

—International Newsreel.

THE latest thrill in motorboating was originated by Al Buffington, outboard motorboat racing champion, shown above doing his "Leaping Lena" act. The speeding boat is driven up an inclined platform, where it shoots off the edge into space, describing an arc six feet high and traveling for more than 20 feet before it meets the water again in a splash of spray.

SHOE PAINTING FAD

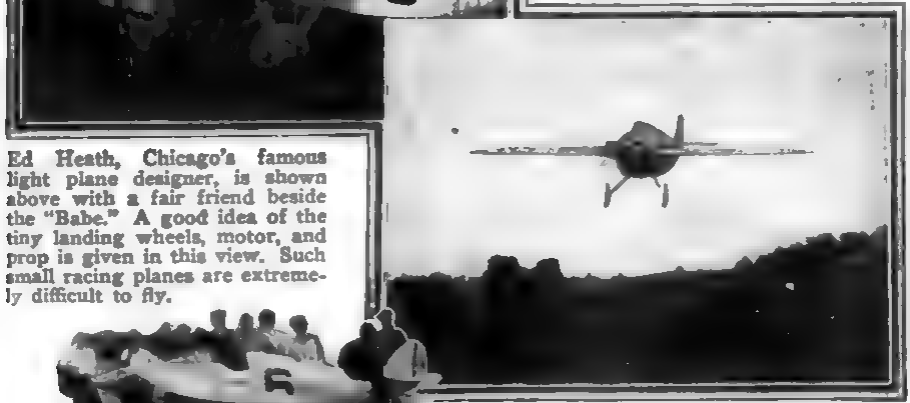
Girls are reviving last year's shoes by painting them with Duco or other quick drying enamels. Shoes can be painted in brilliant colors or in white.

The finish should be applied in a thin coat. Brushing over a part of the shoe which has been coated will result in a gummy finish, quite unlike the desired glassy effect.

Baby Bullet is World's TINIEST AIRPLANE

ON A length of but ten feet, a wing spread of but eighteen feet, and with a light two-cylinder motor of only 29 h. p. Ed Heath's little racer can make 130 miles an hour!

Below is shown the Baby Bullet tearing across the field toward the starting line. The clean lines of this midget ship are a delight to those who know their airplanes and they largely account for the breathless speed this little plane can make.



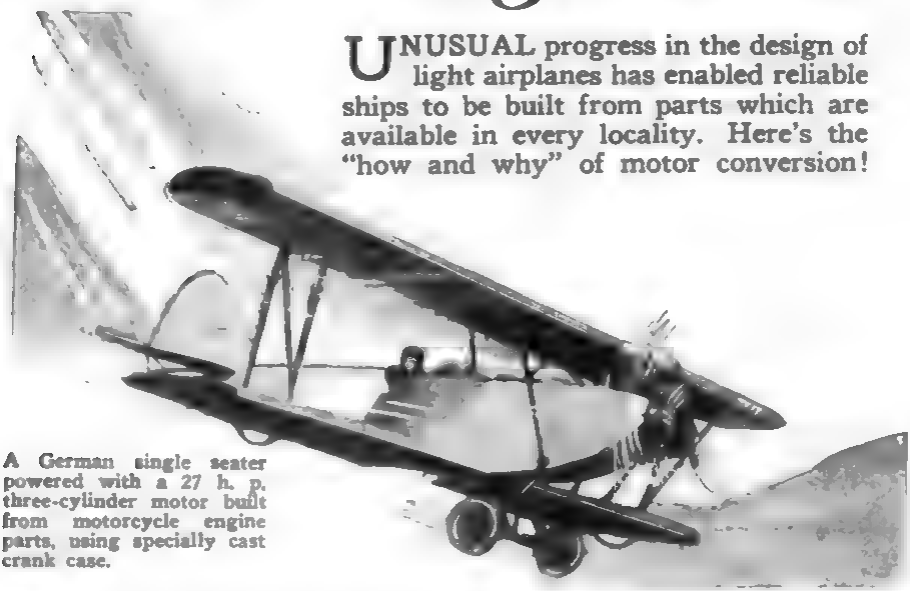
Ed Heath, Chicago's famous light plane designer, is shown above with a fair friend beside the "Babe." A good idea of the tiny landing wheels, motor, and prop is given in this view. Such small racing planes are extremely difficult to fly.

The Baby Bullet weighs 250 lbs. without pilot, has 50 square feet of wing area on a St. Cyr 52 wing section, and a chord of 3 feet 5 inches. The length of the fuselage is but ten feet, while her over all length is thirteen feet. The Baby Bullet is an American version of the famous De Havilland Tiger Moth racing ship recently built in England. Streamline flying wires brace the wings and landing gear.

Though the "Babe" looks like a big grasshopper out on the tarmac, when her 85 lb., 29 h. p. Bristol Cherub air-cooled opposed motor winds up, the "Babe" becomes an infuriated bumble bee!

Aero Engine for

UNUSUAL progress in the design of light airplanes has enabled reliable ships to be built from parts which are available in every locality. Here's the "how and why" of motor conversion!



A German single seater powered with a 27 h. p. three-cylinder motor built from motorcycle engine parts, using specially cast crank case.

MANY attempts have been made in this country to utilize the motorcycle engine in amateur built light planes. A few of these experiments have proven successful and the remainder have been more or less unsuccessful, due to the lack of familiarity many people have with the motorcycle power plant. The majority of automobile mechanics are not suited to experiment or work upon an airplane engine. By the same token neither the automobile mechanic nor the airplane mechanician is familiar enough with motorcycle engines to tune one to its maximum point of performance.

Anyone at all familiar with motorcycles knows at once that a repair job on a motorcycle engine usually cannot be performed satisfactorily by an automobile mechanic. The motorcycle engine is as different from the automobile engine in construction and design as the airplane engine is different from the automobile engine. For that very reason, the majority of attempts made in this country to utilize motorcycle engines in light airplanes have not been extremely successful. In those few eminently successful experiments which have proven the motorcycle engine capable as an airplane power plant, we find the ear-marks of the work of a master motorcycle mechanic. In short, it is the contention of the writer, and it is admitted by many light plane enthusiasts that the motorcycle engine will perform and perform well in a light airplane *if* it is properly adapted.

Increasing Horse Power

There are various motorcycle power plants on the market which will develop from 16 to 20 horse power at from 2,000 to 2,500 R. P. M. These power plants may be obtained either in a form of a four cylinder unit or a Vee Twin. While it is a fact that the four cylinder units will offer

SECOND *of a* COMPLETE SERIES

$25! by T. W. HODGDON

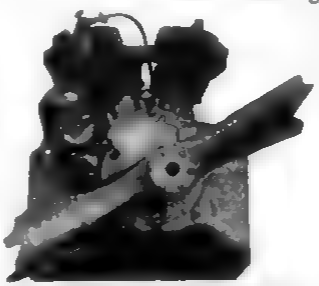
Well known light airplane constructor

The motor is the stumbling block for many light-airplane builders. In this comprehensive article an expert on motorcycle conversions gives the pointers that will enable you to build your own engine from parts costing not more than $25.00—and the power plant will be dependable!

smoother power output and *less vibration* at certain speeds, on the other hand the twin cylinder power plant will offer greater reliability, quicker acceleration and a simplified proposition when it comes to fitting a thrust bearing. We intend to give herewith, a description of nine distinct alterations which may be made in order to increase the power out-put of any of the standard motorcycle power units on the market today. Of these, we strongly recommend the Indian Scout 45, the Indian Big Chief 74 motors, or the 4 cylinder Henderson model K. The Indian Scout 45 motor will develop in the vicinity of 18 horse-power at 2,000 R. P. M., and the Big Chief will develop better than 20 horse-power at the same speed. The Henderson will turn out 27 horse-power at 3,000 R. P. M.

Before taking up the steps necessary to increase the horse-power of a motorcycle unit, we will first describe a suitable thrust bearing and discuss propellers.

First, let us suggest that the propeller be purchased either from the Heath Airplane Company in Chicago, Illinois, or from the Paragon Engineers, in Baltimore, Maryland. Both these manufacturers will either sell you a standard propeller of about 4½ feet diameter, 3½ foot pitch, or they will make one to your order. A motorcycle unit such as we are about to describe will turn a four or a four and one-half foot prop up to speeds as high as 2,500 R. P. M., provided the pitch of the propeller is kept down to within 3½ feet. This propeller may be attached directly to the engine shaft by means of a flange such as we illustrate herewith.



The Indian Chief motor shown here was adapted to airplane use by methods described by Mr. Hodgdon.

Naturally, inasmuch as the propeller pulls the airplane with a thrust as high as 150 or 200 pounds, it will be necessary to fit a thrust bearing to take care of this thrust on the engine shaft. We recommend a Strom bearing No. 7B fitted in place exactly as shown in the sketches herewith. This bearing will take care of all possible thrust and we surely do not recommend an attempt to turn a motor up to speeds above 2,000 R. P. M. with a propeller on the shaft unless this bearing is fitted. Fittings for such a bearing may be made in almost any machine shop at a nominal cost. This recommendation does not apply to the Henderson, which is shown with the Heath Conversion in Figure 2.

Assuming you have seen to it that your motor is in good condition throughout, let us consider the exact things which you must do to it if you are to make your motor faster and snappier. Above all—these alterations will smooth out the average motorcycle engine amazingly.

To obtain a maximum of speed from the stock engine, the following steps can be taken:

The Henderson Motor as developed by Heath of Chicago, develops 23 H. P. on a weight of 120 lbs. It is very reliable.

1. Raise the compression ratio.
2. Install oversize valves.
3. Alter the cam shapes to obtain a greater lift.
4. Bore out intake and exhaust manifolds and polish them. Also polish the cylinder head.
5. Balance the flywheels for speed.
6. Install aluminum pistons.
7. Fit a modern, jet type carburetor.
8. Advance magneto, timing, being sure to fit racing type spark plugs.
9. Improve the lubrication qualities of your engine in every way possible.

Now there are nine points, all of which offer chances for you to get a few more R. P. M.

Compression Ratio

The surest and easiest way to increase the speed of any gasoline engine is to raise the compression ratio. The compression ratio of the average stock motorcycle motor is between 3.5 and 5. On the big twin motors the ratio is comparatively low, being usually about 3.5, while on the small twins and the small side valve singles it may be 3.9 or 4.

To raise the compression ratio of your motor you should take your cylinder or cylinders to a first-class machine shop and there have about 1-8" or possibly 3-16" turned from the base of the cylinder as shown in Figure 3.

The job is best accomplished in a lathe and care must be exercised that the turning is done so that the cylinder will fit down squarely on the crankcase when it is replaced.

This removal of metal from the bottom flange allows the cylinder to fit down closer to the piston, and raises the compression enough to give you several more miles per hour.

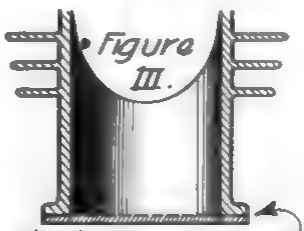
However, it may be well to call your attention at this point to the following:

Pistons Must Be Polished

Raising the compression ratio of your engine increases the power, but it also makes the engine run at a higher temperature. To get good results you *must* use aluminum alloy pistons, you *must* polish the piston top and cylinder head, and racing type spark plugs are necessary.

The reason for polishing the head and piston top is to keep down the possibility of

Raising the compression ratio by this method will increase speed - but care must be taken to see that the ratio is not too high. If it is too high the engine will "pink."



Shaded area is metal to be removed from cylinder base.

If ratio proves to be too high, mix benzol with the gas, or set shims under cylinder. Either one will stop "pinking."

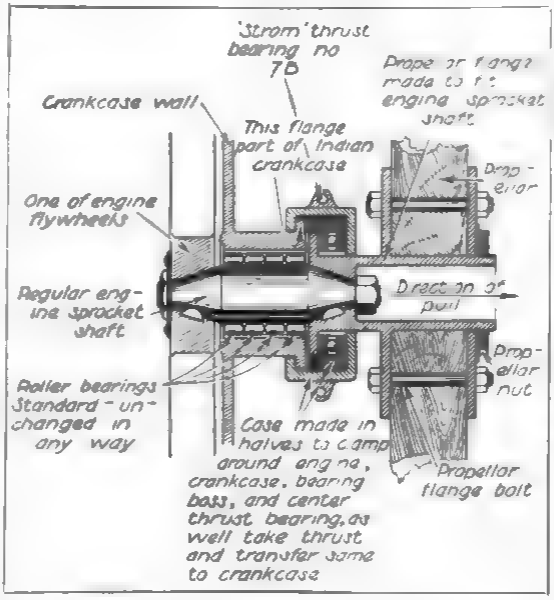
carbonization and preignition. Preignition and detonation will cause you to lose all the advantages you may derive from the increased compression, and polishing will help prevent these. Aluminum pistons will help keep the temperature of the cylinder down, as aluminum is a very good conductor of heat, and will carry heat away from the combustion chamber very rapidly.

The racing type plugs are necessary because they are to work at high temperatures with high compression ratios. An ordinary spark plug will cause the average high compression motor to act queerly and cut out at high speeds.

Now then, assuming you raise the compression ratio, you should polish the cylinder head and piston top. For details of installation of alloy pistons, see following instructions on balancing engine.

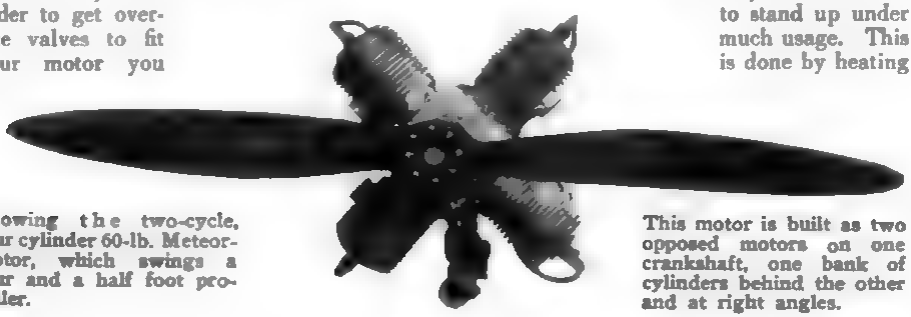
The installation of oversize valves should offer no great problem, but care should be taken not to attempt to install valves which are too large. Very large valves are very apt to warp at high temperatures and will break easily. In order to get oversize valves to fit your motor you may be obliged to purchase automobile valves and cut the stems down.

A greater valve lift will allow your motor to draw in a larger charge of fresh gasoline and get rid of a burned charge with more rapidity. In fact, next to increasing the compression ratio this increasing of valve lift offers the greatest possibilities to obtain an increase in speed.



To alter the cams for lift, you must remove metal from the offside of the cam, the no-lift side. This will allow the tappet rocker to travel through a greater up and down distance. Figure 4 shows very clearly the area of the metal you should remove, while Figure 5 gives the comparative lifts afforded by such a change. If one-eighth of an inch is taken off the cam, a lift of just one-eighth of an inch more will be secured at the tappet.

It will be necessary to soften the cam by heat treating. This is done by heating to a red glow, then cooling slowly in sand. Then it can be filed with a flat file and the surplus metal very easily removed. Hardening by heat treatment will again be necessary if the cam is to stand up under much usage. This is done by heating

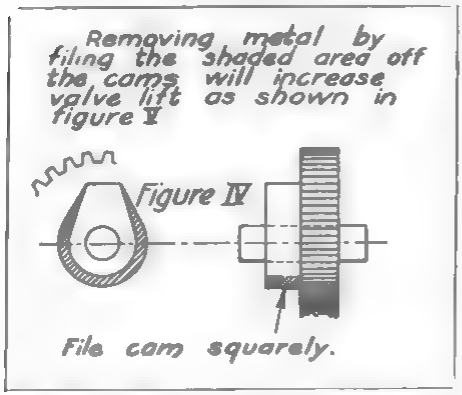


Showing the two-cycle, four cylinder 60-lb. Meteor-motor, which swings a four and a half foot propeller.

This motor is built as two opposed motors on one crankshaft, one bank of cylinders behind the other and at right angles.

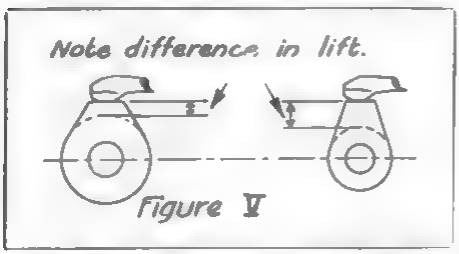
How to Weigh and Balance Reciprocating Parts

and quickly quenching in oil. Be sure the cam is filed squarely. See Figure 4.



Boring Out Intake and Exhaust Manifold

Of course, having made provisions for increasing the valve lift and having increased the compression ratio, it will be necessary to make possible the entry of large amounts of fresh fuel to the cylinder, as more will be needed. In the same way, the exhaust ports will, or should be, bored out so as to allow easier outlet of burnt gases. Figure VI shows how the intake and exhaust passages may be bored out. A good machinist will do this work safely and surely for you. After the boring out,



the passageways should be polished thoroughly with emery cloth on a round stick and later with steel wool. See Figure VI.

Polishing the cylinder head and piston top are also essential to good induction and complete combustion at the proper time.

You will find that the fastest engines in the world have smooth, polished intake and exhaust passages, and that the pistons and heads are also polished.

Balancing the Engine for Speed

It will be absolutely necessary to smooth out the motorcycle engine as much as possible in order to cut down vibration.

If your engine has cast-iron pistons, alloy pistons should be fitted. Aluminum alloy pistons are very necessary to a high compression job.

Having installed lighter pistons, you must take some off the flywheel counterweights. There is a hard and fast rule to weigh the cast-iron pistons, and weigh the new alloy pistons and then take the difference in weight. If this difference is 3 ounces, just 1½ ounces should be removed from the counter weights of the wheels.

In other words, take the difference of the weights of the new pistons and the old ones, and bore out one-half of this weight in the flywheel counterweights.

However, in this case, let us go at it directly, ignoring the hard and fast rule mentioned above.

For speed purposes it will be found quite satisfactory to balance slightly more than half the reciprocating masses. By reciprocating masses is meant the piston, plus rings, plus wrist pin, plus one-third the weight of the connecting rod. The other two-thirds of the connecting rod may be considered as rotating masses.

About six-tenths (.6) of the reciprocating weights will balance any single or "V" twin having one crank pin. The exact procedure is as follows:

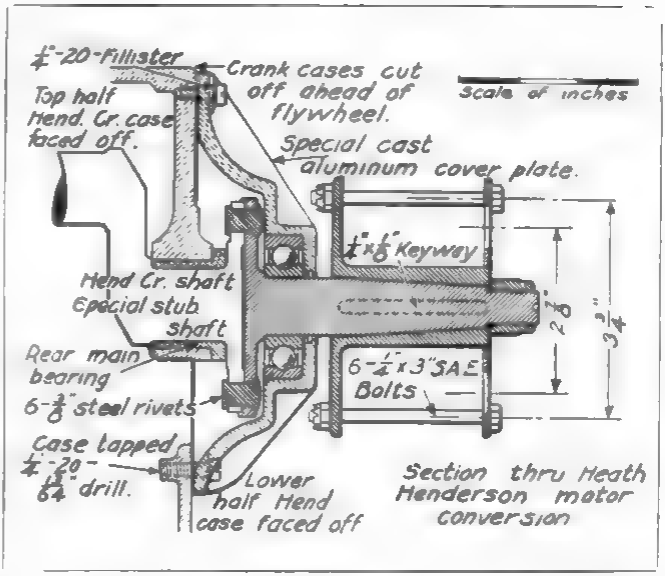
First: A balancing stand such as shown in Figure VII should be built. This is comparatively simple and inexpensive to build, yet will give very good results if used properly. As you will see, it is composed of one piece of board about 12 inches long by 6 inches wide, with four bolts sticking up through it. Onto each of these bolts a piece of 2x2 oak 4 inches long is fitted, free to slide up and down over the bolt for the space of an inch or so. (See sectional view, Figure VIII.)

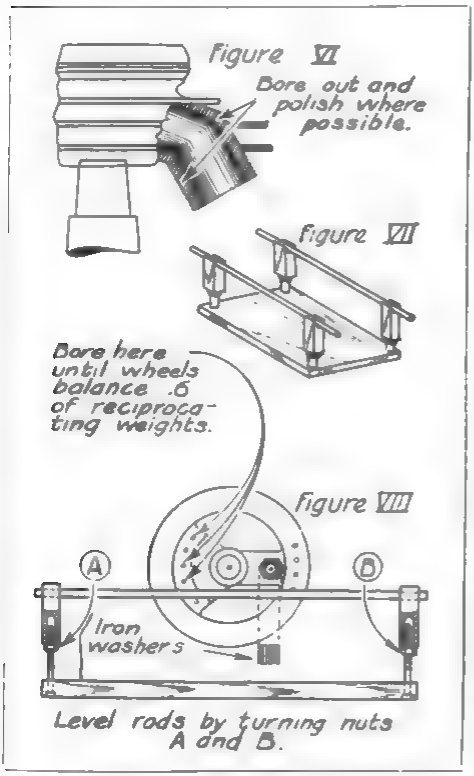
The tops of these 2x2 blocks are grooved to hold the balancing bars shown. These

balancing edges are of 3-8 drill rod. This stand makes a very practical balacing stand when used in conjunction with a spirit level.

The nuts, A, B, C, D, can be screwed up or down, raising the ends of the rods until they are perfectly level. Thus when the flywheel assembly is placed on the drill rods, there will be no tendency for the shafts to roll either one way or the other.

Second: To obtain .6 of the reciprocating weights, weigh the pistons, plus rings, plus wrist pins, plus lock pins,





and set this weight down on paper. Now weigh both connecting rods and take one-third of this weight and add it to the weight you first set down. The total of the two is the weight of the reciprocating masses. Now multiply this weight by .6 or if you prefer, divide by 10 and multiply what you get by 6. This will be in ounces as you started with ounces.

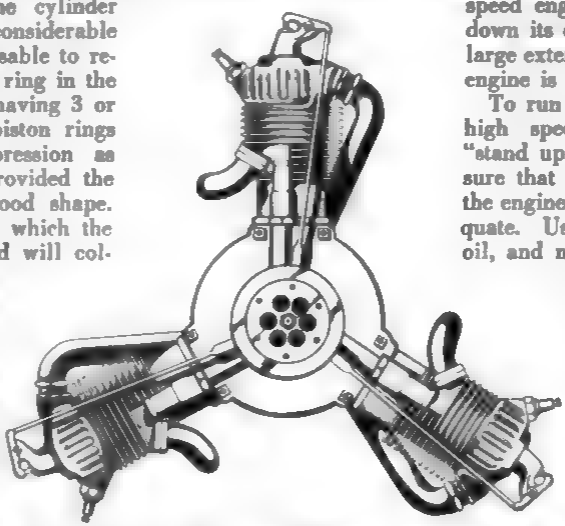
Metal must be removed from the flywheel counterweights by boring them. Of course you do not know how big a hole or how deep a hole to bore, so you should weigh up enough iron washers to make the weight of the reciprocating masses—the weight you got as .6 of the masses. Now pass a wire through these washers so that you can hang this weight on the crank pin of the flywheels. Put the assembly of the flywheels (carefully lined up) on the balancing stand, minus the connecting rods but with the roller bearings on the crank pin. With the weight of iron washers hung on the crank pin, you will find that the flywheel counterweights are too heavy, or in some cases too light. Bore into the flywheel counterweights, taking out metal until the wheels balance without any tendency to roll in either direction. (Of course, in case the counterweights are not heavy enough, the boring can be done in the rim of the flywheels near the crank pin. See Figure VIII.)

Installing Aluminum Pistons

In case you install aluminum pistons, be sure to allow several thousandths of an inch more clearance than was the case with the cast-iron ones. Aluminum alloy expands much more readily than iron and will cause the pistons to bind on the cylinder walls in case a sufficient clearance is not allowed.

Fitting New Piston Rings

The power lost from friction of the piston rings against the cylinder walls is quite considerable so that it is advisable to remove one piston ring in the case of engines having 3 or 4 rings. Two piston rings will hold compression as well as three, provided the cylinder is in good shape. The groove from which the ring was removed will collect oil and cause an excess of it on the cylinder walls if left as was—so it will be found necessary and very beneficial to the performance of the engine to bore about eight 1-16" holes through the piston ring groove. This will allow excess oil to pass back to the crankcase.



By using three left hand cylinders from an ordinary motorcycle engine a very creditable and reliable engine can be made up. The crankcase is the only part which needs to be built, and a casting in Bohnalite will afford much interesting fun for the builder who essays such a job. Cams, valves, crankshaft and con rods are standard motorcycle parts with but little hand work put in on them. Such a motor will produce 27 h. p. at 1,800 r. p. m. It will weigh about 100 lbs.

Fit new rings with a clearance at their ends of about .001. This allows plenty of clearance at high temperatures.

Carburetion

If your engine is equipped with one of the older types of needle valve carburetors you will probably find it necessary to exchange it for one of the later model jet types. The ideal carburetor is one which will enrich the mixture upon a part opening of the throttle, and then lean down the mixture upon a *further* opening of the throttle. The rich mixture is required for acceleration while the lean mixture is required for complete combustion at high speeds. If you have one of the older needle valve types, you will readily note that it does not exactly meet these requirements. The jet types are nearer the above-mentioned ideal and will suit a fast job more readily.

If possible, have your intake manifold bored out and *polished*, and be especially careful to avoid air leaks in assembling it. A small air leak in the manifold of a high speed engine will often cut down its efficiency to a very large extent, especially if the engine is a twin.

To run an engine at very high speeds and have it "stand up," you must make sure that the lubrication of the engine as a whole is adequate. Use a good grade of oil, and make sure that the oil is evenly distributed about the cylinder walls.

That statement may sound vague but it is not. It is possible to increase the circulation of oil in a motorcycle motor in several ways. The Indian Twin engines have a very thorough lubrication system whereby oil is circulated throughout the bearings, which is another reason why they were recommended. First—take out one piston ring, *not* the lower one, and bore holes through the piston through the groove where the ring was. About eight 1-16 in. holes will do. Upon a downward stroke of the piston, this empty piston ring groove will collect oil from the cylinder walls and pass it through the piston via the holes.

It may be of interest to the reader to note that nearly every record-breaking automobile or other motor vehicle has a similar system for preventing "oil pumping."

Blow all your oil lines out with compressed air and take the ball check valves apart from the mechanical pump, and clean them. Adjust the pump to deliver slightly more oil than it formerly did. The engine will be more in need of oil for cooling than for lubricating purposes. Always drain oil from motor base by means of upper drain screw, prior to flight—excess oil will cut down R. P. M.

Timing Ignition Ahead

For a high compression, high lift valve motor, the ignition may be timed ahead slightly for best results. Set the magneto gear ahead one or possibly two teeth. When running an engine of this type at moderate speeds have the spark slightly retarded. The extra advance will prove useful on full open throttle.

Dope Fuels

A high compression engine will operate much more satisfactorily on alcohol or benzol fuels. Many racing motors of very high compression type will not run at all on ordinary gasoline, but must have alcohol or benzol.

If your motor knocks on gasoline, try mixing benzol in small amounts. This will, as a rule, eliminate serious trouble with high compression engines.

Gasoline and Oil Tanks—Controls

Any one or two gallon tanks will do for a gas tank and it must be fitted above level of carburetor. A one or two quart tank will hold sufficient oil for several hours running, and this also should be fitted above level of motor.

Month by month the construction of small airplanes, both land and water types, will be shown. Next month the Heath Parasol, all steel monoplane with high lift wing, will be given to the readers of Modern Mechanics. Never in publishing history such a "how to build" series! Direct all inquiries to the Light Airplanes Editor of this magazine.

Next Month—Plans for This Handsome Plane!

ONLY sixteen feet long, powered with a four cylinder Henderson motor which you can buy second hand in any locality, this *new* super Parasol design of Ed. Heath's will be treated in a typical Modern Mechanics "how to build" article next month!

The old style Parasols used the lower wings of Thomas Morse Scout planes and were good load carriers. Now, with the same Clark "Y" wing section that Lindbergh used in the Spirit of St. Louis an additional capacity of 100 lbs. useful load has been gained, making the little ship a quick climber. The all-steel fuselage with the special Heath weldless riveted joint makes this little sky-wagon a practically indestructible sport ship with a service speed in the seventies. Don't miss this article—*Next Month!*

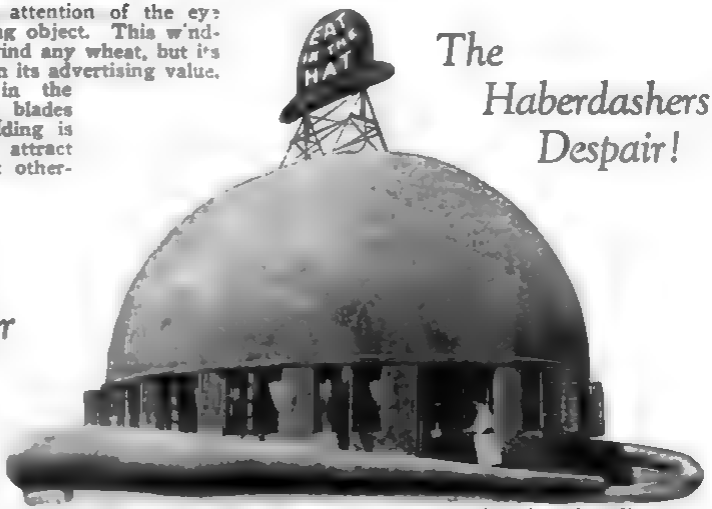
ODD Cafes

NOWHERE in the world are there so many fantastic food shops as in Los Angeles, where stunt cafes built in the shapes of windmills, shoes, dolls, and Eskimo igloos have largely replaced conventional restaurants. Atmosphere is further carried out in the names appended to these odd establishments—Ptomaine Tommy's popular eat shop competes for business with the Quick and Dirty, and customers not attracted by the Take-a-Chance can dine in the Monkey's Den.

Nothing attracts the attention of the eye so quickly as a moving object. This windmill bakery doesn't grind any wheat, but its owner is cashing in on its advertising value. An electric motor in the cupola keeps the big blades turning, and the building is sufficiently unusual to attract customers who might otherwise pass it by.

Atmospheric Hamburger Shops!

The Haberdashers Despair!



In this restaurant they never pass the hat for the after-dinner entertainers—it's too well anchored to terra firma. Top quality steaks are the specialty of the democratic Brown Derby cafe on Wilshire Boulevard, Los Angeles.

from California

Fantastic Food Shops

Marvels of Mechanical Skill

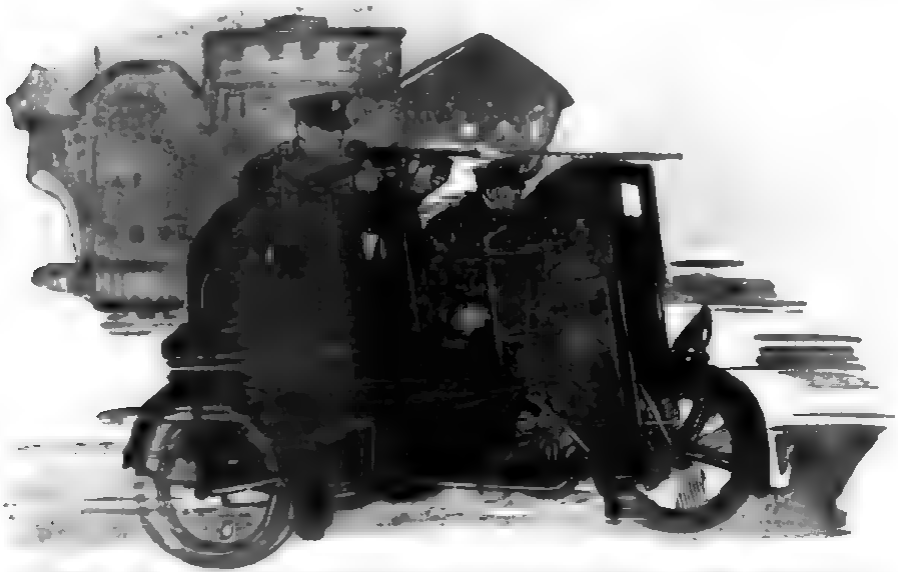
"Eat here and see the world" might well be the model of this enterprising restaurateur. The working parts of an old windmill have been removed and a dining room built on top of the tower. It looks like a blockhouse from an old fort.

Here is the shoe where the Old Lady lived—all fixed up as a restaurant and labeled the Mother Goose Pantry. Mother Goose herself is anchored to a circular track on top of the shoe, around which she drives her goose whenever the wind blows. Regular diners in the shop praise the chef for his shoestring potatoes and filet of sole.

YOU can eat dinner in a jail cell in Los Angeles, served by waiters in striped convict clothes, but it's all in fun—just the Californians' way of adding a thrill to the meal. Even if the food doesn't please, you're bound to get your money's worth from the scenic background.

Although the handle of this giant freezer has been turning twelve hours a day for several months, it hasn't yet produced a nickel's worth of ice cream. Fake? Not at all! It's a refreshment stand, not a factory as might at first be supposed. And of course it's located in Los Angeles.

GANGLAND'S



To fight the armored cars and motorcycles used in dealing death by Chicago's organized murderers, Chicago police have been forced to use the same weapons. This bullet proof racing fort equipped with armor, shatterless glass and a sub machine gun can beat the fastest armored bandit autos. Nothing but bombs can stop it!

AS MAN has progressed from the ox-cart to the automobile in transportation, from the candle to the electric light in illumination, so he has progressed in the art of murder.

An instance of this is the manner in which the Chicago gangs have utilized modern methods in disposing of their enemies.

First came the "strong arm" age in which the gangsters beat their enemies with fists. Later a more efficient weapon, the blackjack, or "billy." These weapons were crude and seldom meant death to the individual to be punished. The pistol superseded these and had a long reign, which has not entirely come to an end.

Sprays Lead Like Garden Hose

After the pistol came the sawed-off shotgun, a sure-fire killer. With modern progress, especially since the war, the machine gun has been in vogue. This instrument of death, which sprays lead as a garden hose sprays water, is now the favorite weapon of the Chicago gangsters, and its deadly fire has snuffed out the life of more than one man who lived by his wits and incurred the enmity of his fellows.

Another mechanical device has enabled the slaughter to go on apace. This is the automobile. With it a group of gangsters may speed up upon an individual or group, turn loose a hail of machine gun bullets and escape with great rapidity. A powerful car of some common make is ordinarily used, without license plates, so detection is difficult.

The bomb, cunningly constructed, of iron, usually, is another weapon used by the gangsters. This, however, is not used as an instrument of death, but is merely used to destroy property and to serve as a warning.

Death Machines

By MANLY S. MUMFORD

CHICAGO CORRESPONDENT

SPEEDING past a bootlegger's auto, an armored car pours machine-gun death into the other, sending it crashing to the curb, and another gangster has been killed by his rivals! Mr. Mumford, Chicago police reporter, has written vividly of the death machines of the gang feudists.

No one has ever been killed in Chicago by a gangster's bomb. But many houses have been wrecked and buildings shattered.

Killings Deliberately Planned

The gang killings are not sporadic outbursts of anger, nor murders committed in the heat of passion. They are cold judgments by one group of gangsters upon others in the group, or upon public officials who have deceived them, or upon outsiders trying to break in on their lucrative professions or "rackets," as they are known in Chicago slang. A "racket" is any illegal method of making a living.

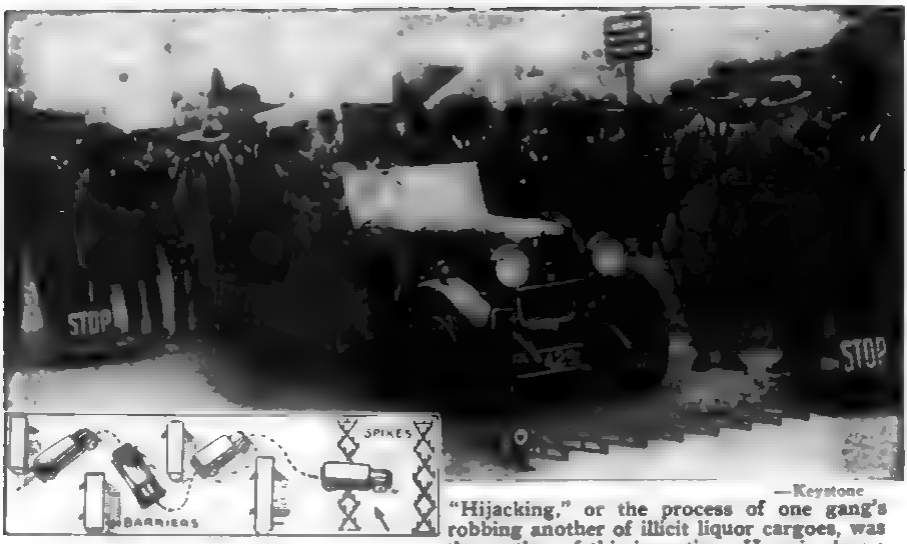
The latest victim of gangland's vengeance is Tony Lombardo, Sicilian feudist and so-called "King of the Chicago Mafia." A bootleg partner of Scarface Al Capone, his death is the latest outburst of violence from that bubbling, slumbering volcano which is Chicago's underworld.

Lombardo was walking along the street with a bodyguard, Tony Ferrea, in the heart of Chicago's loop. Without warning the dum-dum bullets started crackling. One of them caught Lombardo in the back of the head, killing him instantly. Ferrea was mortally wounded. The assassins escaped.

This gangster atrocity is a handbag which throws blinding poisonous gas at officers.

A veteran gangster, Lombardo's death calls attention to the history of the big Chicago gangs. This history began before the war, when men fought and died for the control of labor unions.

One man desirous of



—Keystone

"Hijacking," or the process of one gang's robbing another of illicit liquor cargoes, was the mother of this invention. Here is shown a hijacker's car which has been stopped by a spike-tong which punctured all the tires. Police have borrowed the invention to use in place of barriers, which are ineffective, as a car can thread its way through them, merely being slowed down.

dominating such an organization gathered around him a few sluggers, usually ignorant hoodlums with the proverbial strong back and weak minds. Ordinarily there was no murder. If a stubborn candidate refused to withdraw from the campaign for president of a union his opponent sent out his muscular hirelings and they administered a beating which changed his mind. He would nurse his broken nose for a few days and fall in line with the stronger man. Sometimes he was slugged with a blackjack.

Occasionally a more courageous and stubborn individual failed to heed such warnings and he was killed. There was little technique about the murders and very little planning. The sawed-off shotgun and the machine gun had not yet come into their own. This was the "strong arm" age.

This more or less desultory labor warfare went on for a few years without many casualties and with few names of prominent gunmen or employers of gunmen being brought to the fore.

"Rackets" Are Profitable

In 1920 when the underworld began to realize the financial possibilities of the bootleg business, larger gangs began to take form. At first the Irish were the leaders and there was little strife. The profits from the sale of beer, whiskey, wine, and alcohol were enormous and the demand was large and steady. The chances of being caught and prosecuted for violation of the law were not great and the penalties normally were light. A tough Irishman would gather around him a few friends and they would engage in business. There was no set section of the city for each gang, but each sold where he could. Occasionally one member of the gang held out part of the profits which belonged to the gang as a whole and he was executed. Here the pistol was the favorite method of disposing of the cheater.

Gradually competition among the illicit sellers of liquor became keener; the smaller fellows were frozen out, partly by fear of the larger gangs and partly because they found it more profitable to ally themselves with a larger and more closely knit organization.

Italians Control Gangland

About this time the control began to pass from the Irish to the Italians, where it still remains.

The first of the Italians to attain great

Machine Guns Mow Down Victims in Gang Wars

prominence was Big Jim Colosimo, a product of the notorious Five Points gang in New York, which has produced so many tough gunmen and murderers and sent them out to ply their trades in other cities.

Colosimo, large of stature and soft of voice, consolidated many of the whiskey and alcohol sellers under one management. He also departed from the former regime and included gambling houses and houses of ill repute, all outside the law.

Big Jim's restaurant, patronized by many people not gangsters, became famous as part of the city's night life. Colosimo himself was always in evidence, bowing to patrons, keeping order, and serving fine Italian food. As he rose in power he sent to New York for Johnny Torrio, a former member of his gang in New York. Torrio was even smoother and more suave than his boss, Big Jim. He also was more up-to-date and progressive in his use of weapons.

Torrio also had a good business head and organized the illegal business along more efficient lines. Then began the regular campaign to keep the business. Other men, not associated with Torrio or Colosimo, tried to start saloons, gambling houses, disorderly houses. A few days after they had started some emissary of Torrio would call upon them, warning them of the futility of continuing in competition with the Colosimo gang. If they failed to heed, they were bombed.

If this sinister warning went unheeded, the foolhardy individual was murdered. This was still in the days of the pistol.

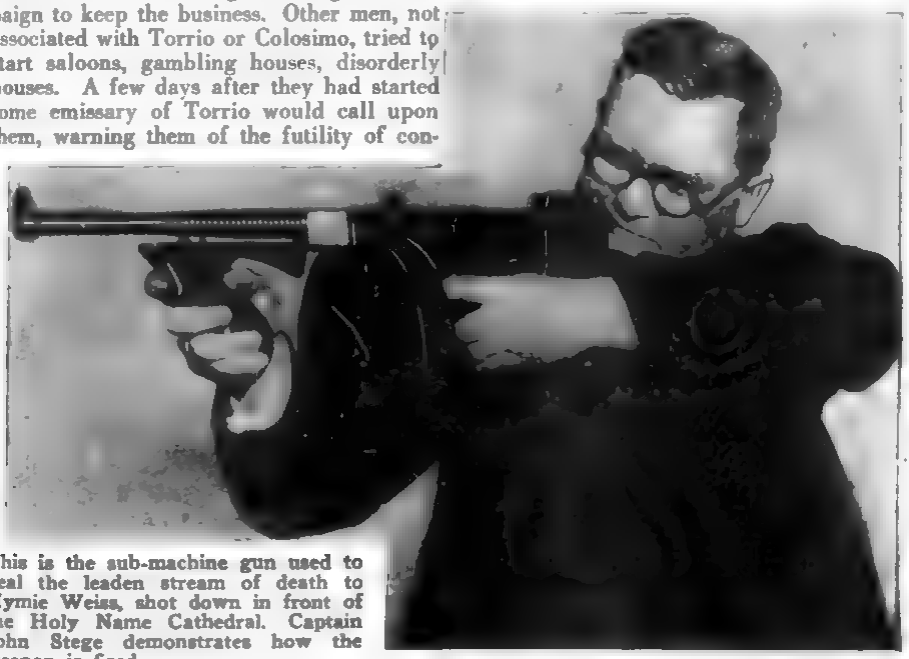
Colosimo Killer Still Free

Colosimo waxed fat and rich. He was the undisputed underworld king of Chicago and Torrio his right hand man. Around them were gathered a choice gang of gunmen, swarthy, quiet, ill dressed, keeping out of the limelight.

Then one night Big Jim was shot. Enemies invaded his restaurant, called him into the hallway and many bullets found their mark near Big Jim's heart. Officially no one knew who shot him. The police never solved the murder and if his friends knew who killed him, they never told.

"Scarface Al" King of All

Torrio then took the reins and ruled with an iron hand. Tighter and tighter became



This is the sub-machine gun used to deal the leaden stream of death to Hymie Weiss, shot down in front of the Holy Name Cathedral. Captain John Stege demonstrates how the weapon is fired.

These Gangsters Were MARKED for DEATH in

TONY LOMBARDO
Murdered partner of Scarface Al Capone

SCARFACE AL CAPONE
King of Chicago's Bootleggers

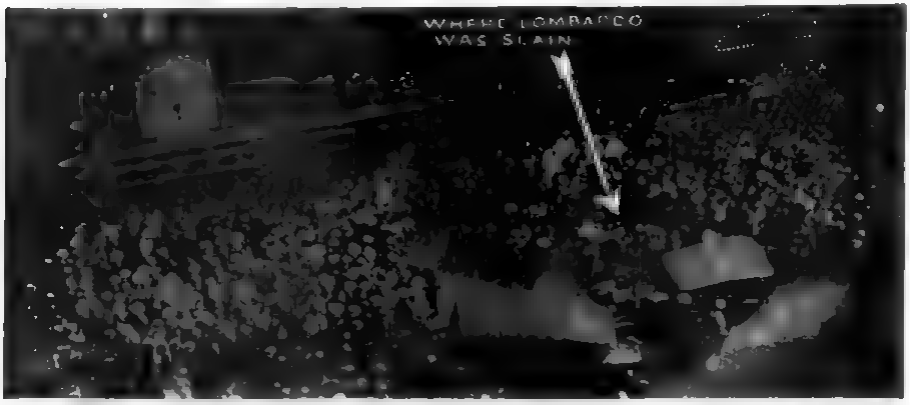
HYMIE WEISS
Victim of rival gang strife

the ring and harder and harder to break into the illegal business without the approval of Torrio. He sent again to New York and brought out Al Capone, "Scarface Al," destined to become the king of them all.

Torrio and Capone began to take in, as employees and gunmen, men from nationalities other than their own. Dion O'Banion, a swaggering Irishman from the north side, was taken in. Little Hymie Weiss, of Polish descent, a good business man and bookkeeper, joined the ring. "Bugs" Moran, with an Irish name but Polish ancestry, was allowed to work for the syndicate.

O'Banion and Weiss, shrewder than the rest, saw the enormous profits reaped from the liquor business and decided to try it on their own account. They had no money but had brains and courage.

Their first attempts were "hijacking." That is, O'Banion and his companions, knowing a truckload of liquor was being transported from one place to another, would lie in wait along a country road. When the truck appeared the O'Banion gang would set upon it, shoot or kidnap the driver, steal his truck, liquor and all and resell it. This was profitable because the liquor cost them nothing and they sold it high.



—Keystone.

The latest victim of gangland's wrath was Tony Lombardo, bootleg partner of Scarface Al Capone. The arrow points to the spot where ambulance men are picking up the body, a few minutes after the dumdum bullet was fired into the back of his head as he walked down a street in the heart of Chicago's loop.

CHICAGO'S Wholesale Gangland MURDERS

DION O'BANION
Murdered Irish florist-bootlegger

"SCHEMER" DRUCCI
Paid his debt to society

JOHNNY TORRIO
Who brought Scarface Al to Chicago

Wholesale Slaughter Ushered In

Here began the real gang wars of Chicago. The sawed-off shot gun era was ushered in.

The old fashioned revolver, which had done yeoman service for so many years, was less sure than the newer type of weapon, which viciously spits out its leaden slugs a dozen at a time.

The first of the victims of the big war were "bumped off" in the fall of 1923. George Meeghan and "Spot" Bucher, O'Banion hijackers and beer runners, were riding peacefully along in their auto one afternoon when another car pulled up along side of them. Shotguns were poked from between the side-curtains of the second car. They blazed away and Meeghan and Bucher were dead. The killers' car sped away unobserved by anyone.

From September until Christmas day ten bootleggers and beer runners lost their lives, nearly all of them ambushed and filled with lead from the shotguns. Most of them were the smaller fry, little heard of and unimportant, even in gangland.

The war went on into the next year, with one or two a month being killed.

The O'Banion gang grew in power and the Italians' range decreased. The "North side mob," as O'Banion's gang was known, in contrast to the Italian gangs, who inhabited the south side, also grew rich and prosperous.

O'Banion, always fastidious, gathered around him more of his ilk and put them in evening clothes. In the daytime his vicious crew hauled beer, whiskey, alcohol and sold it to the small saloonkeepers. In the evening a half dozen of them, attired correctly in tuxedos, attended the theatre accompanied by their wives or sweethearts, the latter dressed in evening gowns and mink wraps. Later in the evening the party would adjourn to a first class hotel for supper. Their identity was not known. Many of them were handsome, their tips were lavish and the waiters in the hotels were overjoyed to see them come.

Wedding of O'Banion

Finally Dion himself, the ruler of the gang, was married.

It was an evening wedding and all the guests, principally gangsters, came in full evening dress, white gloves and all. The wedding was held in a good residential section of the city and went off well. Occasionally a suspicious bulge was noticed beneath a swallow tailed coat, because, even at a wedding, a gunman couldn't be without his gun.

Once in a while one member of the gang, usually a lesser one, was found dead, murdered. He was mourned by his fellows, soon forgotten and another took his place. None of the leaders, O'Banion, Weiss, Moran, Drucci, Dapper Dan McCarthy, had lost their lives.

Weapons of Science Wage War on Gangsters

The last named pair were among the most colorful of all the gangsters. McCarthy, living up to his name of "Dapper Dan," was an old time labor slugger, pleasant, affable, nattily dressed and fearless. He brought a wide knowledge of gangdom and a pleasant personality. Vincent Drucci, known as the "Schemer," a tall, slender, handsome Italian lad, was easily the pick of the gang for looks. He came from a good Italian family, was intelligent, pleasant spoken and clean cut. His English was far from the "dese, dose and dem" of the old time gangster.

Flower Shop Is "Blind"

O'Banion also ran a legitimate business, that of floristry. He had a well appointed flower shop near the "Gold Coast," where the wealthy and socially prominent of Chicago live. Many of them were his customers, little suspecting the ruthless spirit in the genial Irishman.

With Dion running his flower shop, Drucci and Moran ensconced in sumptuous hotel apartments, the money rolled in from the bootleg business, splendid parties being held for the "North Side mob." They were in clover.

Then the bolt fell.

Dion was slain.

On the tenth of November, as Dion was tending his posies in the flower shop, four Italians walked in, ostensibly to order flowers for the funeral of a noted Sicilian who had passed away naturally. One of them grasped Dion's hand, a purely friendly gesture, shaking hands with an acquaintance. As he did so the other Italians opened fire with revolvers, and Dion fell mortally wounded, with his blood staining the orchids and lilies around him. His life's blood ebbing away mingled with the red roses he had tended and darkened their crimson.

The killers, their car parked outside the shop, ran out, jumped into their powerful car and sped away. No one could be found who saw them.

Dion had been alone in the shop and he lay there dead, his unused gun beside him.

War Flames Flash

Again the war between the gangs, dormant for a while, flamed into fire. By Christmas again, a half dozen more gangsters had been slain.

In the year 1925, forty-three gangsters or men affiliated with the gangs were assassinat-

Giving the gangman his own medicine! Bank messengers, to protect themselves, have resorted to the heinous poison gases used by bandits. Here's a gas gun in action!

—Keystone.

Dope-crazed men, money hungry, look upon murder merely as an incident in the day's routine. Newspaper scareheads follow the activities of gunmen such as the man in the picture. It is not the lone desperado which society fears, however, so much as the human wolves who run in gangland's pack.

ed, the shotgun being the most popular means of snuffing out life.

The war grew in proportions through the year of 1925 and 1926. It was a dull week when the Chicago papers did not have at least one gangland murder to feature on their front pages.

Then came the machine gun era, more deadly and remorseless than the others. The pistol, the rifle, even the sawed off shotgun missed occasionally. Once in a while a gangster marked for death recovered from his wounds and, revengeful, started after his enemies.

The O'Banion gang was the first to suffer from the machine gun.

Across from O'Banion's flower shop is an old Catholic cathedral, Holy Name. On a pleasant afternoon little Hymie Weiss, who had succeeded O'Banion as the ruler of his clan, drew up in front of the cathedral in his automobile. Following him in another car were more members of his gang, accompanied by an attorney, who was defending another gangster on trial in the criminal courts for murder.

As Weiss and his companions sauntered across the street toward the flower shop, still their headquarters, there came the vicious rattle of a machine gun. Weiss fell mortally wounded, O'Brien, the attorney fell, two others dropped.

Hymie Weiss Checks Out

Next door to the flower shop is a remarkable house where two rooms are rented. Some three weeks before the assassination of Weiss and his companions, two quiet Italians had rented a room, on the second floor, facing the Cathedral. For three long, weary weeks they had waited, watching for Weiss to show up. When he came they were ready for him and turned loose the murderous machine gun. Again the O'Banion gang was without a leader, and the face of Holy Name cathedral was marred with bullet marks. Stone from the front of the church was chipped away by the leaden slugs.

It was not long until the machine guns barked again. At night this time. A bootlegger named Doherty, and one named Duffy accompanied by Bill McSwiggin, an assistant prosecuting attorney of the county, pulled up in front of a saloon in Cicero, headquarters of the Capone gang. As they started from the car an automobile swerved in front of them and the wicked rat-a-tat-tat of machine guns broke loose. Another car be-

hind, also equipped with a machine gun, turned on its deadly fire.

Duffy, Doherty and McSwiggin, the prosecuting attorney, were all dead, riddled with dozens of pellets from the guns. The front of the saloon looked like a target range. The victims' car had fifteen holes in it. Four hundred shots must have been fired by the killers. They made sure this time that they did not miss.

Another unsolved murder was added to the list of hundreds already on the police books. Grand juries investigated. Police and detectives scoured the town. Gangsters were arrested and thrown in jail. The state's attorney, whose assistant McSwiggin was, threatened vengeance on the killers, but so far as the officials know they are still at large.

As gang warfare continues other improvements taking advantage of mechanical progress will undoubtedly be used. Already threats have been made to use airplanes. It would be an easy matter to drop a hundred pounds of high explosive upon a gangster's haunt from a plane.

Meanwhile the warfare goes on with the weapons at hand. Occasionally a truce is called and the slaughter stops for a time. But some one breaks the armistice, gangland emerges from its quietude, machine guns bark again and another gangster is given a fine funeral.

Movies Borrow Gangland's Weapons for "Racket" Pictures

Stopping at nothing in efforts to secure realism, producers of the picture "Underworld" equipped George Bancroft with this sub machine gun, taken in raids by Chicago police.

This motorcycle, armored exactly as it was when it took part in a thrilling gangland war, was borrowed by the movie producers for use in sequences based on incidents in some of the battles it has come through. Note the machine gun, the armored shields of bullet proof steel, the shatterless triplex windshields and the powerful battery of headlights. Such machines were adopted by Chicago police to combat gangsters after the gangs had introduced them into their rum running wars.

Drop a Nickel! *Mechanical Salesman* Does the Rest

Truly this is a mechanical age—even the job of the salesman is now taken over by machinery. The German machines shown on this page are designed to deliver all sorts of package goods when coins of the proper denominations are deposited. Some even say "Thank you!"

This tin newsboy says "Thank you!"

—Keystone Photos.

Five brands of cigarettes are sold from this one machine. No need to wait while the salesman is busy with other customers—just drop your money in the slot, and the deal is completed.

Razor blades at a drop of the coin! This youngster is making his first purchase. Note the large size blade mounted at the top of the machine—advertising and salesmanship combined!

CHEWING gum was the first commodity to be vended mechanically in the United States. Now plans are under way which will put mechanical salesmen in hotel lobbies, subway entrances, and other strategic locations where the man who runs may buy. This is in line with the American idea of substituting creations of brass and steel for human hands.

Floating Hotels of

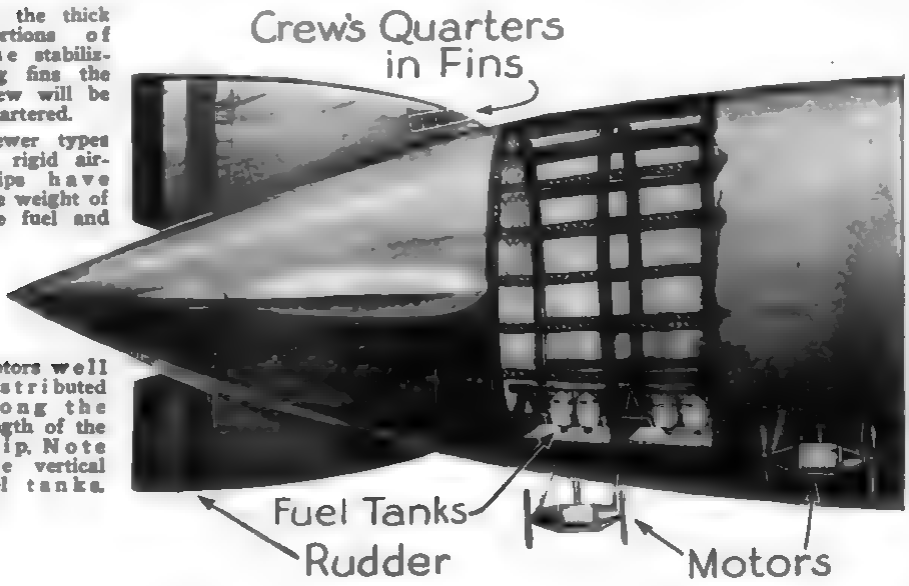
CROSSING the Atlantic in 50 hours, in the huge air liners being built in England and Germany, will soon be achieved, marking the most revolutionary step in aeronavigation since the invention of the airplane. All the luxuries of a first class hotel are offered in these leviathans of the air.

WILL the new mammoth airships under construction in England and Germany confound the critics and prove the commercial possibility of world travel in huge liners? That is the question to which an answer is anxiously awaited by thousands of interested people.

In face of the disasters which have previously attended large-scale experiments of the kind, and in spite of predictions of failure, the British Air Ministry believe the problem of building safe dirigibles can successfully be solved. They are demonstrating their belief by building two amazing ships which will soon be ready to make their trial tripe.

The new airships are fascinating in their bold conception and the ingenuity of their design. The British Ships are known officially as "R 100" and "R 101." The German airship is the "Count Zeppelin," which recently completed its trial flight of 650 miles in less than seven hours and is now ready for service.

The "R-100" follows the well-known Zeppelin practice in certain features of her design. The longitudinal girders are of the customary triangular form, but novelty is introduced by making both the girders, and the frame rings, in separate units, held together by detachable joints. If any girder becomes damaged, it can easily be replaced, without having to cut out the dam-



In the thick portions of the stabilizing fins the crew will be quartered.

Newer types of rigid airships have the weight of the fuel and motors well distributed along the length of the ship. Note the vertical fuel tanks.

Cloudland

by PERCIVAL MARSHALL

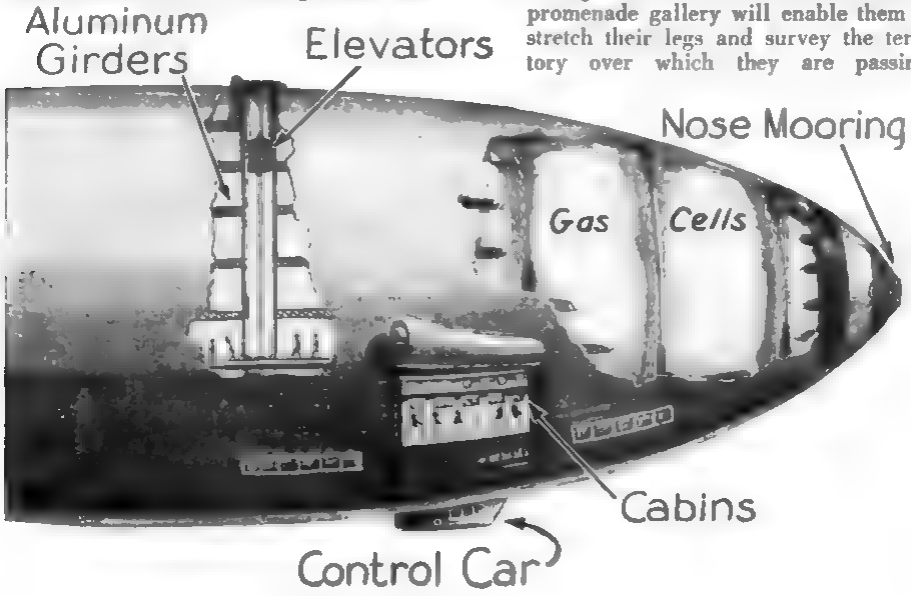
London Engineer

aged part and rivet a new length in its place. The metal used is duralumin. The booms of the girders are circular in section, and are formed by rolling up a long strip of sheet metal spirally, so that the edges overlap. These overlapping edges are then riveted together.

Each longitudinal girder is built up with three of these booms, joined together by lattice work, and the girders are all curved to a streamline form. This added much to the work of construction, but it is anticipated that the reduced air-resistance offered by the body of the ship will fully compensate for the extra cost and trouble involved.

This is an actual photo of the luxurious salon of Germany's latest liner of the sky, the super-rigid Count Zeppelin. One would think it a view of the drawing room of some stately ocean liner rather than the accommodations afforded by a passenger-carrying hotel of the sky!

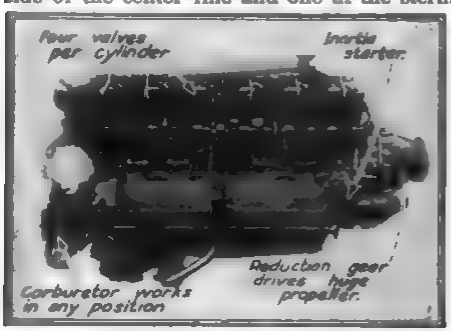
Luxury is the keynote for passengers. Contrary to previous practice in air liners of this kind, the whole of their quarters will be situated within the main framing of the ship. They will sleep in cosy two-berth cabins, arranged on two decks, and an extensive promenade gallery will enable them to stretch their legs and survey the territory over which they are passing.



The left view shows the galley of the Count Zeppelin. The extensive use of aluminum to make bulkheads, tables and tanks is well shown. At the right is one of the berths in a stateroom on the same airship.
—International Newsreel.

Meals will be prepared by an expert chef in an all-electric kitchen, and they will be served at table under conditions similar to any first-class restaurant. They may even have their game of bridge, but I doubt whether the designers of the ship will permit any sky-high dancing. Fifty couples stepping out the "Yale Blues" might do more damage than the fiercest Atlantic gale.

The crew and the main controls of the ship will also be housed within the hull. Engine nacelles, or "power-eggs," of which there will be three, are located one at each side of the center line and one at the stern.



Salient points of the Rolls-Royce "Condor" engine, six of which will be used in the R-100. These motors are twelve cylinder and develop 650 h. p.

Each engine nacelle will house two Rolls-Royce Condor gasoline engines, of 700 horse power each, so that 4,200 horse-power will be available from the six engines.

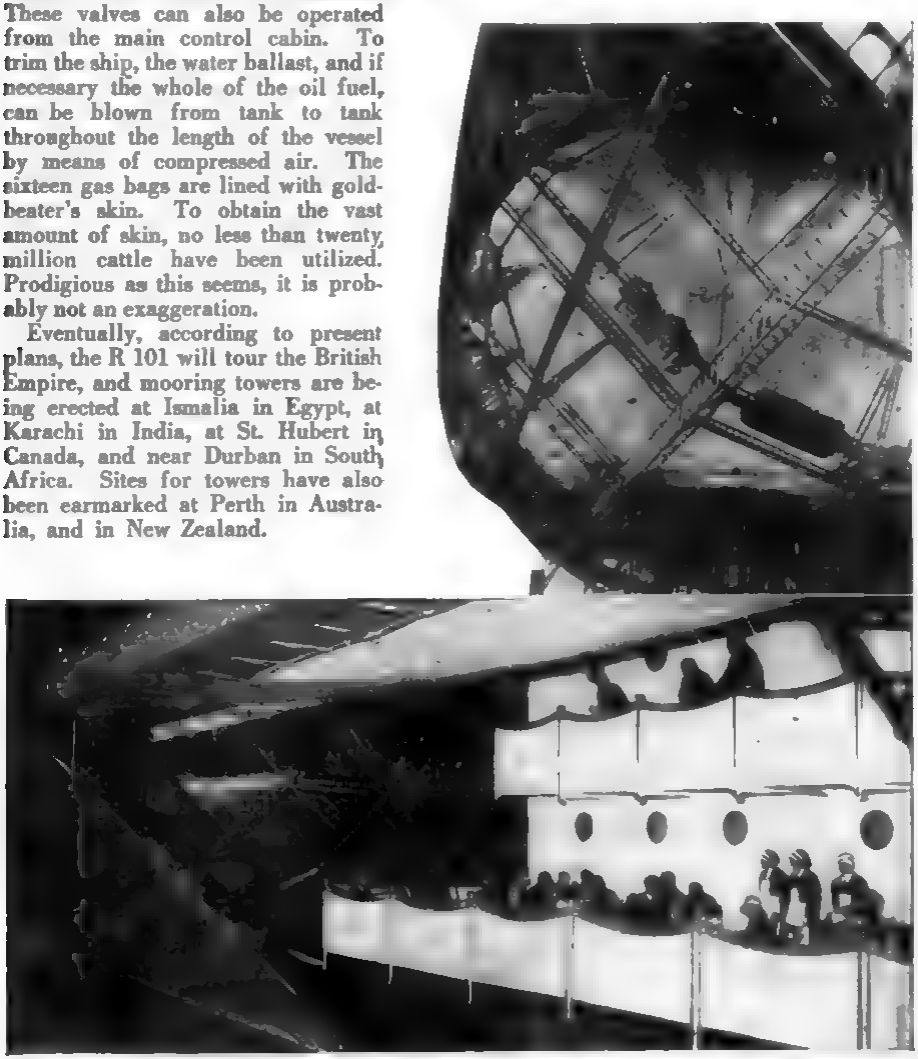
The length of "R 100" is 709 feet, and the maximum diameter 130 feet. The displacement is 5,000,000 cubic feet. It is estimated that the maximum speed will be about 82 miles per hour, and at a cruising speed of 75 miles per hour, the ship will be able to undertake a fifty-hour flight, covering 3,750 miles. Thirty tons of fuel will be required for this trip. The ship is designed to lift 73 tons, including the crew and fuel, together with 100 passengers and ten tons of freight.

The R 101 will have girders of steel tubing instead of duralmin, and crude oil will take the place of gasoline as fuel for the engines. This use of the crude-oil engine is an interesting and important experiment, since it will make the ship much safer for travel in hot countries, and will do much to improve the condition of the atmosphere in the accommodation quarters. Five Beardmore engines will be used for propulsion, and an auxiliary gasoline engine will be installed in each nacelle to start up the main power plant. Crude oil costing 25 dollars

a ton will be used. Enough fuel will be carried to give a cruising range of 4,000 miles. The air-screws have blades of variable pitch; these can be reversed and, if desired, can also be set in a neutral position giving no thrust at all. Special valves are provided to release gas automatically in the event of a sudden rising of the ship through the action of vertical air currents. These valves can also be operated from the main control cabin. To trim the ship, the water ballast, and if necessary the whole of the oil fuel, can be blown from tank to tank throughout the length of the vessel by means of compressed air. The sixteen gas bags are lined with gold-beater's skin. To obtain the vast amount of skin, no less than twenty million cattle have been utilized. Prodigious as this seems, it is probably not an exaggeration.

Eventually, according to present plans, the R 101 will tour the British Empire, and mooring towers are being erected at Ismalia in Egypt, at Karachi in India, at St. Hubert in Canada, and near Durban in South Africa. Sites for towers have also been earmarked at Perth in Australia, and in New Zealand.

The R 101 is slightly larger than its sister ship R 100, being 730 feet in length, but the diameter is the same. The increased length will provide rather more spacious accommodation for the passengers. The dining-room, seating 50 people, is on the upper deck, where there is also a large lounge Steam radiators warm the ship.



Promenade decks give the semblance of an ocean liner on the R-100, England's mammoth airship. Glass will cover the hull at this point. Above is shown structure of the gas cells in the new R-100 being built in England. The gas bag can be clearly seen. Gas tanks on the girders are fitted with quick dump valves.

Above is a view of the hangar with huge ballasted machine-closed doors. Below this is a view of the wheel house and chart room of the airship. At the bottom is a view of the radio operator's quarters.

In the first few months trial flights will be made at home, but when these are satisfactorily completed, Egypt and India will be visited by R 101 in the fall of next year. The gasoline-engined ship "R 100" will not be suitable for the tropics, but she will, with good fortune, negotiate the Atlantic trip with ease. Commander Burney, her designer, is particularly anxious to bring her over to the United States.

If tourist and commercial transport by airship is to become established, much financial support will be needed, and this may naturally be looked for as freely from the United States as from Great Britain.

No date is given for the launching of either of these ships, but it is expected that one at least will be found floating at her 200 feet high mooring tower by the end of December.

Some details of the famous Rolls-Royce "Condor" engines which will form the power units of "R 100" will be of interest. Each engine has 12 all-steel cylinders giving a normal out-put of 650 horse-power at 1,900 revolutions per minute. The cylinders are 5½ ins. bore and 7½ ins. stroke, and are fitted with water jackets of die-pressed steel, acetylene welded at the joints. Two inlet and two exhaust valves are provided for each cylinder, these being operated by over-head camshafts and rockers. The valves are made from special high chromium steel forgings, working in phosphor bronze guides.

The normal speed of the propeller is 907 revolutions per minute, the reduction from the crankshaft speed being effected through a 477 reducing gear.

The pistons are of a special aluminum alloy, each piston being fitted with four rings. Three of these are compression rings above the gudgeon pin, and the fourth is at the base of the skirt, acting as a scraper ring. The six-throw crankshaft is also machined from nickel chrome, the journals and crankpins being bored for lightness.

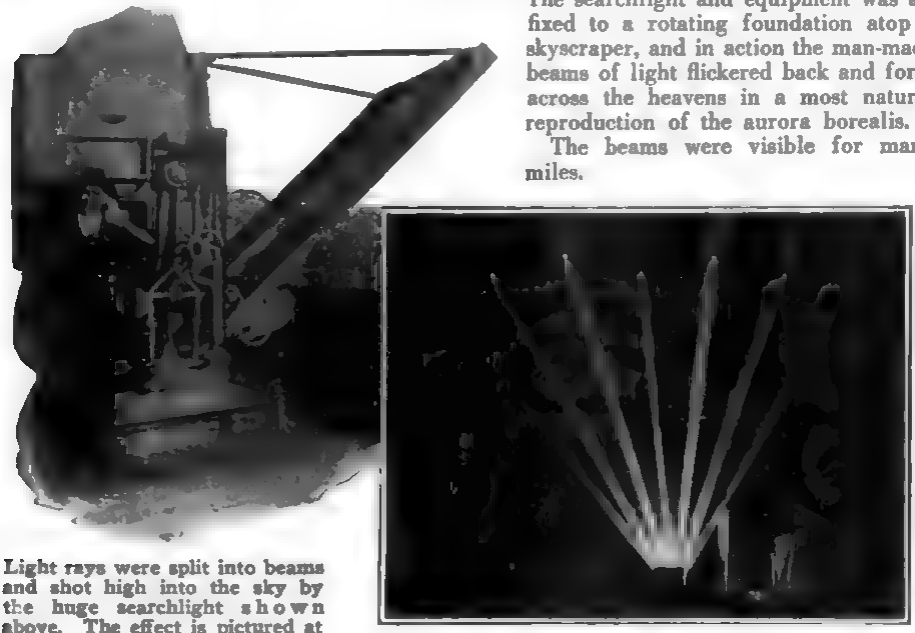
Northern Lights Made to Order With Searchlight

IN ORDER to provide an elaborate display of Northern lights at the recent Shriners' convention in Miami, Fla., it was necessary to devise special equipment for the purpose.

A Sperry 60-inch high intensity arc searchlight giving a beam candle power of one and a quarter billions was installed. Light from the huge lamp was split into beams which shot high up into the dark sky.

The searchlight and equipment was affixed to a rotating foundation atop a skyscraper, and in action the man-made beams of light flickered back and forth across the heavens in a most natural reproduction of the aurora borealis.

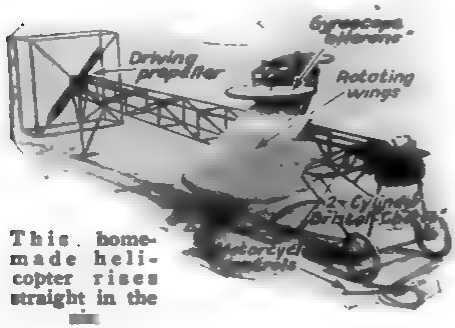
The beams were visible for many miles.



Light rays were split into beams and shot high into the sky by the huge searchlight shown above. The effect is pictured at the right.

HELICOPTER STABILIZED WITH GYROSCOPE

PROFESSOR Zascha, a German aviation authority, has designed a light skeleton-like airplane which will rise vertically from the ground.

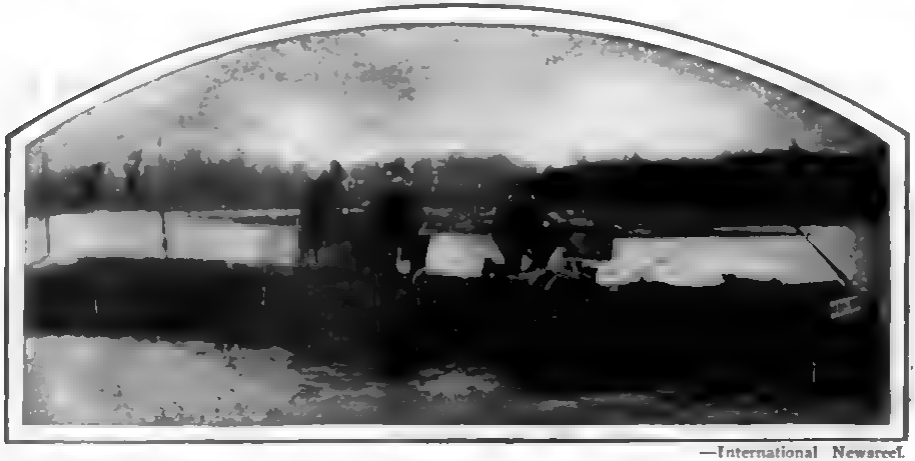


This home-made helicopter rises straight in the

Using ordinary bicycle wheels as landing gear, the aluminum tube plane, which is of the screw lifting type, employs a light weight two-cylinder opposed motor developing thirty horsepower. Through a belt the power is transmitted to the tail propeller, which furnishes the forward thrust. At the same time the rotating wings, which really are large, slow-turning propellers, are driven from this belt. Instead of having ailerons there are two gyroscopes mounted above the rotating wing which keep the ship level at all times.

This plane or helicopter was flown successfully at Berlin Central Airport during the past month. Note the remote cables (motorcycle control cord) by which the ship was controlled from the ground.

Log Houseboat is Floating Home for Lumberjacks



—International Newsreel.

LUMBERJACKS along the Cowlitz river in Washington have solved the problem of the high cost of living. By simply snaking to shore a huge log from the river drive and installing their domestic equipment thereon, the loggers are able to float downstream enjoying all the comforts of home.

The lumberjacks shown in the picture are enjoying a comfortable meal on their floating home. A galley-range which once saw service as a camp stove is installed on the after deck of the "ship," where the cook turns out steaming stacks of flapjacks for his hungry cruisers. Dishes, knives and forks, table and benches—all of the necessities, in fact—are provided on this fir log of 10-foot diameter.

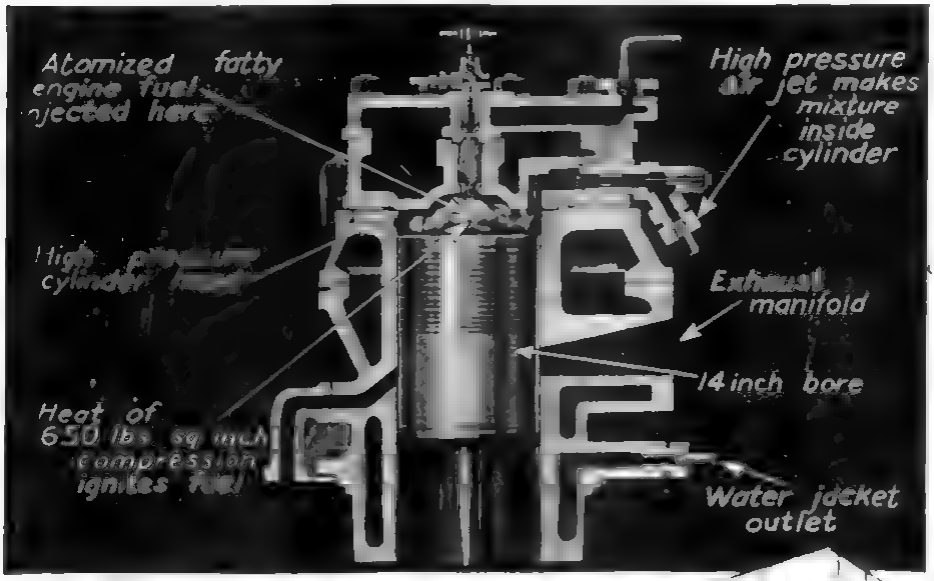
The streamers between the masts in the bow of the boat are not flags strung to dress up the yacht for a gala occasion. A clothesline has been strung between two peaveys and the lumberjacks' red flannels are hung out to dry after they have been laundered by being towed astern. On the stern of the ship, just under the poop deck, the voyagers have fastened a "Keep Off" sign designed to keep homesick salmon from invading the privacy of their quarters.

Monorailway Handles Ship Freight

A UNIQUE suspension railway for the handling of package freight from ocean going vessels is being constructed at Hamburg, Germany. It is of the monorail type. A track on which the carrier runs is suspended from an overhead cable running between gigantic tripod towers. This overhead cable, like the cable of a suspension bridge, has members bridging the gap between the natural parabola formed as it swings from tower to tower, and the rail. The rail is by this means made to run level no matter what the terrain may be underneath the road. The car is driven by electricity.

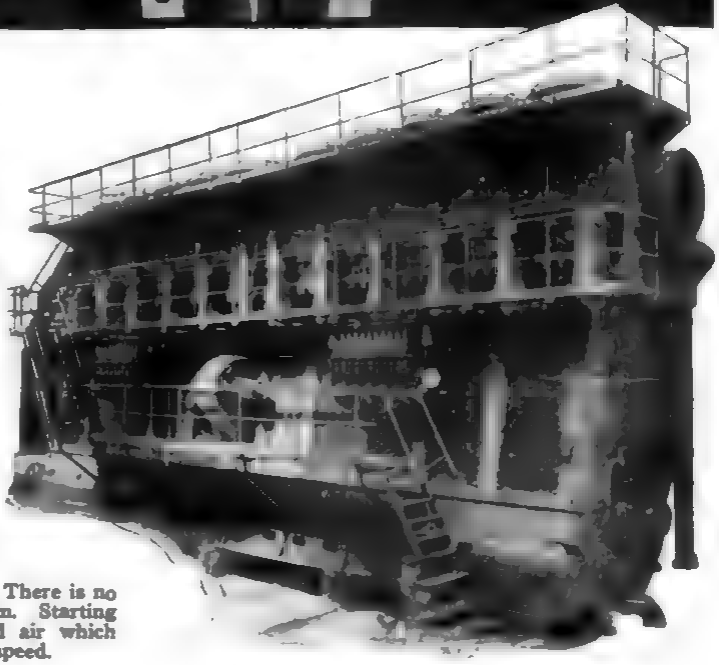
ENGINE RUNS ON BUTTER!

Fatty Waste Furnishes Fuel for Huge Engine



11,700 Horsepower!

WHILE this gigantic internal combustion marine engine really uses distillate for fuel, it can be run on sour milk, melted butter, old axle grease, lard, bacon drippings, cold cream, cod liver oil, liquid soap or even skimmed dishwater! Any fuel of fatty content, liquified, can be injected into the cylinder, where mixed with air, the heat of the engine's enormous compression explodes the fuel as the gasoline charge is exploded in your automobile. There is no electrical ignition system. Starting is done by compressed air which turns the engine up to speed.



Here's the Second FLYING Lesson

By PILOT GENE SHANK

Holder of the World's Endurance Flight Record for Light Airplanes

GENE SHANK'S first Flying Lesson appeared in the November issue. In it Gene had a breezy "chin session" with the Hangar Gang, showing how to take off, fly straightaway, and land again. Here the youthful record-holder gives the gang some pointers on banking the turns and steering the old bus. Don't miss a single one of this series!

WELL, gang, here we are lined up for another look-see at the warmed-up ship. Last time we talked about taking off and how to bring a takeoff to a happy ending by landing safely. This time something ought to be said about the fine art of turning. It *is* an art, and don't let anyone kid you!

You remember when you were a kid in grade school and had a bicycle? And when you wanted to turn it you had to "bank" your turns so as to maintain equilibrium? You have to do the same thing with an airplane in order to keep from coming to grief.

The reason that bicycles and airplanes are alike in this respect is that they are delicately balanced right over the center of weight. If you go to turn a bicycle, the weight of the wheel and rider being so far above the ground and tending to go right on in the direction they were going before the turn was started, will try to throw the rider. In an airplane, if a turn is started without provision being made for offsetting this the tendency is for the weights to continue in their original path of flight—that is, if the plane isn't banked, the most beeyootiful things are apt to happen. The plane will skid like a greased pig—so badly that it may lose flying speed and have to be put into a dive to regain control. Or it may roll around tail-end-to and begin to spin.

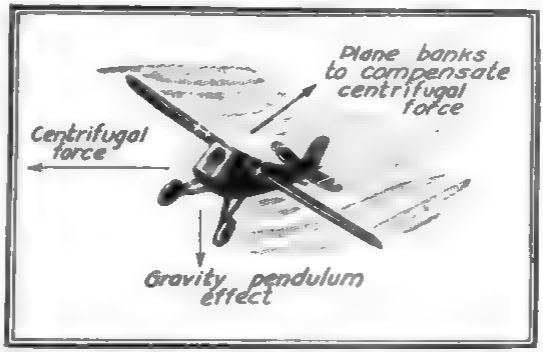
To offset the phenomenon of physics which decrees that all things, when once started in motion, tend to continue in the same direction, the ship is banked so that the lift on the wings counteracts this tendency. The drawing explains how this is effected.

For the sake of illustration, let us suppose we have yanked the old bus into the high places. We have been doing straightaway flying, letting you get the feel of the controls, and letting you damp out the rough spots which dip the wing now and then as we tear along at a 100-mile droning gait. Things have been going well and we decide to execute a few turns.

For wide turns the rudder is gently and firmly given slow little kicks in the direction it is desired to turn. As most ships have their centers of weight lower than the center of total lift, there is exerted a pendulum effect which practically takes care of banking on such a turn. However, a slight movement of the aileron must be brought to bear to level the ship out when coming out of the bank and flying straightaway again.

Making Wide Turns

Here is a point to bear in mind on the use of the rudder: if the rudder is kept continually at an angle there is danger of swinging the tail around. A ship can be very easily over-ruddered, and as soon as the pilot feels the ship beginning to yaw, counter rudder must be applied. Therefore it must be remembered that the plane is guided with the rudder in much the same way a boat is coaxed about a turn. When the rudder is set the ship does not follow its dictates immediately, as happens when the wheel of an auto is turned.



In turning, the weight of the plane tends to keep her going in the direction of the arrow marked "centrifugal force." To counteract this the plane is banked, so that all three forces indicated by arrows are in equilibrium. The pendulum effect of stable airplanes will care for banking on wide turns, and will right the ship on the straightaway.

Suppose now we want to negotiate a tight bank—that is, make a quick turn. The wing is coaxed down, the rudder having been previously applied to start the ship into the turn. Then another queer thing happens, such as can only occur with a machine moving in three dimensions of travel. As the wing is brought down, what originally was the rudder has now turned at almost right angles and occupies the place formerly held by the elevators. The elevators have become rudders. Actually, though the description sounds difficult, this switch of function is quickly made a part of one's subconscious action and the feat is readily mastered by anyone of normal physical abilities.

Proper Bank Is Felt

Here it will be well to check for proper amount of bank, because it is possible to overbank a ship just as easily as it is to skid it. If the pressure on the seat increases evenly, and there is no swish of wind on either side of the face the bank has been properly executed. If the inside cheek feels a rush of wind the plane is slipping in. Less bank should be applied. If the wind pressure is on the cheek to the outside of the turn, the plane is skidding and more bank should be carried.

When you can execute turns with the proper amount of bank, we will head for the home field, and I'll give you an actual test of landing on your own initiative. Then we'll pile out and wait till next month for a little bit longer lesson on some of the stunts of aerobatics, including the flight-testing of light airplanes such as are being built by the score by readers of Modern Mechanics. And they're all great little ships, mister! The Heath Parasol which is scheduled for next month is as quick and active a little ship as any pilot ever flew, short of an out-and-out racer. She can be powered with a four cylinder Model K Henderson 23 h. p. motorcycle motor and will carry the average pilot of 150 lbs., plus a good 100 lbs. more just for good measure! But wait till you see her plans in the next issue! She has steel tube fuselage, aluminum seat, a full complement of instruments, the same kind of wing with a Clark Y section that Lindy used in the Spirit of St. Louis when he flew the Atlantic, and she is just the ticket for the young pilot who wants to roll up flying time for that transport license! In the meantime—I'm giving you the stick buddy!

World's Largest Safety Pin is One Yard High

–Keystone.

ENOUGH metal to make 4,400 ordinary safety pins is contained in the world's largest pin, recently manufactured for display purposes. Six and one-quarter pounds of brass was used in making it. It stands 37 inches high, as tall as the youngster in the picture. Six pounds of brass will make 18,000 small safety pins, or at the rate of 3,000 to the pound of metal. It requires a pull of about fifty pounds to close the point of the big pin.

MICROSCOPE IN PEN

A microscope which resembles a fountain pen and can be carried in the coat pocket has been put on the market for use of physicians and students.

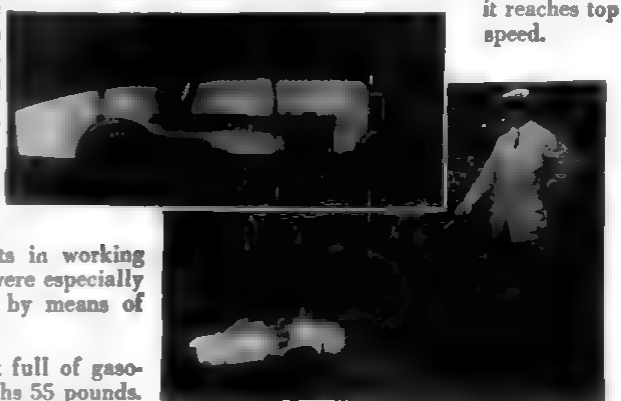
MEXICO ENFORCES METRIC SYSTEM

Mexico is determined to enforce the metric system as the standard of weights and measures. Various Indian tribes of the country have vague measurements of their own, and in the cities American and English merchants sometimes lapse into pounds and quarts in advertising their wares. To enforce the metric standard, authorities are fining shopkeepers who advertise their products in pounds instead of kilos.

FOUR CYLINDER GAS ENGINE PROPELS MODEL AUTOMOBILE

A MODEL automobile only three feet long which faithfully follows the lines of racing cars has been completed by Hans Jansschuetz of Baden-Baden, Germany, after several years of work. Perhaps the most difficult task in building the model was the manufacture of the motor, which is a four-cylinder water-cooled type which works exactly the same as in large cars. Hours of painstaking work were required to machine the tiny cylinders, make special spark plugs, assemble a tiny carburetor and put all the parts in working order. The pneumatic tires were especially made for the car. Drive is by means of sprocket and chain.

The car complete with tank full of gasoline ready for road work weighs 55 pounds. It can develop a speed of 17 miles an hour. The driver races along behind and controls throttle, brakes and steering by means of wires. When in action hot gases flare from the exhaust and the tiny motor roars like a real racer out to win a speedway cup. Its owner is hard put to keep up with it when it reaches top speed.



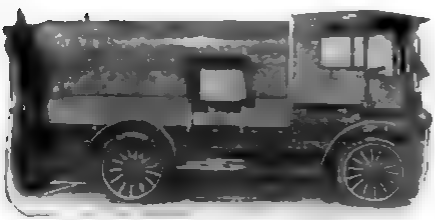
This model automobile has a real four-cylinder gasoline engine which is controlled by driving wires as shown in the above picture.

Big Time-Ball Sets Watches in Washington

FOR forty years the great time-ball shown in the photograph has announced the arrival of high noon to Washingtonians. The unusual time-telling device is attached to a flag pole atop the State, War and Navy Building. It is electrically operated from the master clock at the Naval Observatory, which sends time "flashes" throughout the country. Promptly at 11:55 each day the ball ascends to the top of the pole, being lifted by the cables shown attached to its upper surface. At the precise moment when the sun crosses the meridian a button is pressed and the ball drops. It falls into a funnel-like steel cylinder slightly larger than the diameter of the ball itself, so that the imprisoned air is cushioned underneath the ball to soften the shock of the fall. The flagpole and ball are visible from almost any section of the city of Washington.

—Keystone.

SCALE-TESTING TRUCK HAS UNUSUAL FEATURES



Above is the new scale-testing truck adopted by the New Jersey Department of Weights and Measures. At the right is shown the small truck, with the block and tackle ready to load it with a 500-lb. weight.

OLD methods of testing the accuracy of public weighing scales have been relegated to the discard by the development of a special truck adopted by the New Jersey Department of Weights and Measures. Fifty pound weights were formerly used in scale-testing, which meant that 40 weights had to be moved in testing one-ton loads.

The new truck contains a block and tackle running along a steel track inside the body. A smaller truck weighing exactly 500 pounds is lowered by one man with the aid of the tackle, and the desired combinations of weights are lowered upon it by the same means. When loaded with 2,000 pounds one man can pull the small truck easily about to different positions on the scale.

X-RAYS LOCATE BROKEN AIRPLANE SPARS

AIRPLANES suspected of having broken spars inside the wings can be examined without removing the wing covering by using a portable X-ray machine recently perfected. A similar machine is designed for veterinary work, such as the early detection of ringbone in horses.

X-rays are also proving useful in foundries where expensive castings are poured. The X-rays will detect blow-holes and other imperfections in castings.

Zoo Freaks

AT $10,000 per giraffe, $8,000 per rhinoceros, and $20 per running foot for pythons, it doesn't take long for even a modest zoo to represent a large investment. Nor does everything go along swimmingly once you have assembled your animals. When the hippopotamus gets a toothache, it isn't simply a question of sending him to a dentist—you have to tie him down and go after the bad molar with a crowbar. Oh, for the life of a zoo-keeper!

The longer the giraffe's neck, the more he's worth in the animal market. Giraffes are the most expensive of the common zoo animals. This one is three years old and stands 10 feet high. He is worth from $7,500 to $10,000.

The armor plated rhinoceros costs about $8,000. This old battleship looks like a survivor of the pleistocene age.

$20 a foot is the current quotation on good healthy pythons. It takes half a dozen men o carry this specimen about. It is 26 feet long and is worth $530. Tongues don't count.

Cost MILLIONS

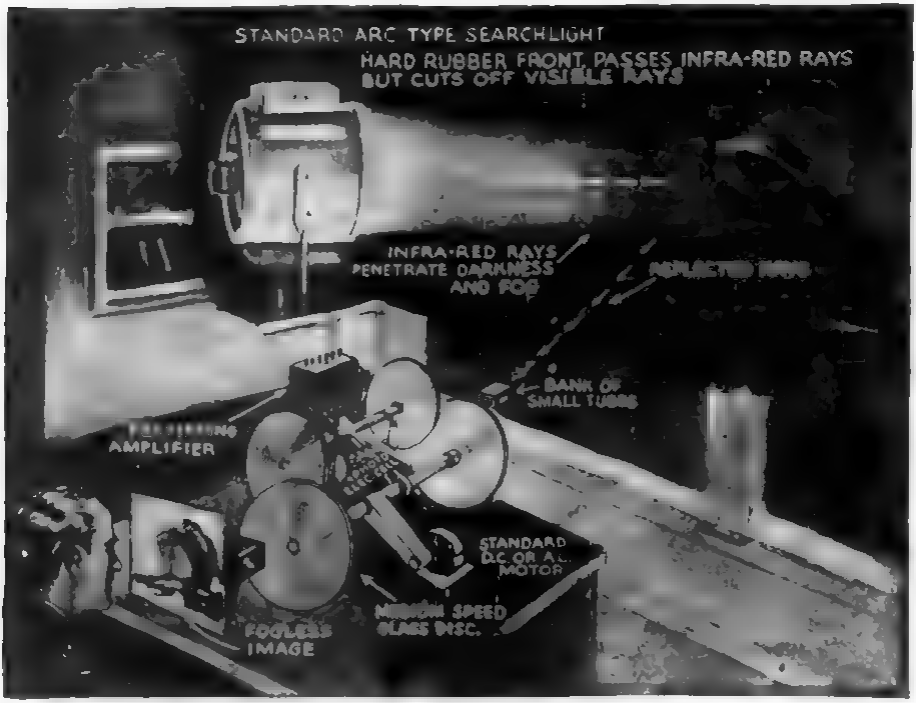
WHEN you pay a dollar for admission to a private zoo, you probably think the proprietor is all sorts of a profiteer. As a matter of fact, each elephant he has cost him about $6,000, and in addition to this cost, there is the upkeep expense represented by five or six tons of hay every week. Elephants are long-lived, but gorillas and other animals do not thrive in captivity. By the time the animals have died, they must have paid a profit for the money invested in them. Figure a quarter of beef per lion per day, stack the costs up against the admission fee — and figure out your own income tax return.

—Keystone.

Aviating elephants! Here's one all set for a three-point landing.

Zebras are comparatively cheap—only $1,000 to $2,000 each. This is because they are still quite numerous in Africa. However, even at these low prices the herd in the picture is worth capturing. It should bring the owner between $15,000 and $20,000.

How Ships Can See in Fog and Dark



TELEVISION has made it possible for ships to be safely navigated in any weather, and under all conditions of visibility. By the use of the Baird system operators on the bridge of a ship can now see, upon a screen in front of them, all obstacles and hazards to navigation no matter how dark the night or how foggy the weather.

Aboard the vessel being navigated by this method there is a lens which gathers the reflected rays of infra red light and sends them through a series of rectifying circuits through a neon lamp to a rotary lens from whence the beams are projected upon a ground glass surface. The resulting image is presented in rectified form, stripped of fog or darkness. The device is said to be a revolution in shipping circles.

LIFE-SAVING WITH OXYGEN HELMET

WILLIAM ADAMS of the Los Angeles fire department found out that his oxygen helmet was of genuine service to him when he staged a "rescue" of the fair Miss Ethel Hyatt. He brought her up from the bottom of the pool where she was supposed to have sunk in the throes of drowning (only she wasn't). The fire laddie dived boldly down with his helmet equipment and rescued her without losing a single breath. Pass the Carnegie medals, please.

Four Miles is Range of New Locomotive Whistle

A LOCOMOTIVE air whistle operated from the same tanks that supply power for the air brakes has been adopted by the Chicago Great Western Railway. It can be heard at a distance of from four to five miles, yet at close range is unusually soft of tone. In principle it is similar to distance-penetrating foghorns, in which sounds of various wave lengths are harmoniously combined with the result that there are no shrill overtones and the warning signals carry for long distances. A high note carries for long distances, while a low note can best be heard at close range. By harmoniously combining low, high, and intermediate tones in the new railway whistle, unusual carrying power has been obtained. Four horns are used in the new device, each set at a different angle as shown in the photograph.

MACHINE PHOTOGRAPHS CHECKS WHEN CASHED

A DEVICE which protects banks from fraud by photographing every check on which payment is made has been invented by George L. McCarthy, shown in the picture holding a strip of film containing the facsimiles of 16,000 checks. He calls his machine the Recordak.

It is attached to an ordinary adding machine and automatically photographs each check as it is listed. The Recordak is loaded with safety film of the type used in amateur movie cameras, and the used portion is removed at the close of business each day, leaving the unexposed film in the camera.

The new machine protects depositors of the bank by producing a fascimile of the cancelled check in cases where the original is lost and repayment of a bill is demanded. It also has a moral effect on the bank employes, who know that checks are photographed on the day they are paid and are consequently not tempted to hold out funds.

This combination adding machine and camera is used by banks to photograph checks as they are cashed.

HE'S BEEN WORKING ON THE RAILWAY

Forty years at the locomotive throttle with 600,000 miles of railway traveling put behind him is the record claimed by Tom Topping of Huddersfield, England. There's no life like that of the locomotive engineer, he says.

GOLD in YOUR

By ORVILLE H. KNEEN
MINING ENGINEER

—Ewing Galloway.

These rough diamonds were found in the great mines at Kimberly, South Africa, source of most of the world's diamonds. They are worth over $5,000,000 a pound, or 1,000 times as much as gold!

ALONG the muddy banks of the Schuylkill River, just behind Philadelphia's Museum-to-be, a remarkable gold mine recently opened for business. For a few days it yielded pure gold—and then was covered up forever!

The "mine" was an almost vertical dump, aite of the new embankment, down which was flowing truckload after truckload of dirt excavated from the site of a very old building. One day some children, playing in the soft dirt, picked up several shiny yellow discs, neatly minted and stamped $1, $5, $10 and $20, dated 1834 to 1873. Next day the latest gold rush was on.

Ice picks, shoe horns, toy rakes, garden trowels, the garden variety of sticks, picks and shovels, scraped the "pay dirt." Soon rain converted it into clay and mud, but the mining went on. Not all the 500-odd gold seekers reported their finds. Several truckmen filled their pockets and failed to report for work next day.

Not far from $3,000 was mined, it is estimated, excluding a bag of shiny coins planted by a practical joker, which assayed pure brass. A luckier digger picked up a bag of real coins, about $500 worth, probably buried half a century or more ago by someone who mistrusted banks. Even a roll of old greenbacks was found, reliably reported by an observant darky as "wet, but good, spendable money."

Hard-hearted city fathers and hard working contractors, intent on getting their work done, finally drove off the feverish hunters of sudden wealth. And thus was buried permanently the only mine on record in which the output was 100% profit—unless the gold-diggers charged up the value of their time, plus incidental costs of removing mud and clay from boots, clothes and persons.

Open Eyes Bring Riches

Out in Goldfield, Nevada, a house was built twenty-odd years ago, when Goldfield boomed with diggers and seekers of gold. A miner who ran a hoist at the Mohawk mine needed a home. So he built himself a rock dug-out in the side of a hill, plastering the walls with mud. When the boom became only an echo, he abandoned his home to stray lizards and rattlesnakes.

One day a Mrs. Moroni got a "hunch." She picked up her prospecting pick and climbed up to the ruins. Where the adobe mud had fallen from the walls her sharp eyes caught the white gleam of quartz. She chipped out a few pieces, crushed and panned them. Colors! The gold assayed $8 a ton. Her husband obtained a lease on the old work-

Own BACK YARD

Millions of dollars were lost to the Boer farmers of Kimberley, South Africa, because they trod underfoot hundreds of shiny stones without realizing that they were spurning a king's ransom in diamonds. Mr. Kneen, well-known mining engineer, here gives some interesting pointers on how to recognize sudden wealth when you stumble upon it.

ings, and uncovered richer quartz. Goldfield is now taking on a new lease of life where Columbia Mountain lifts its bare crown.

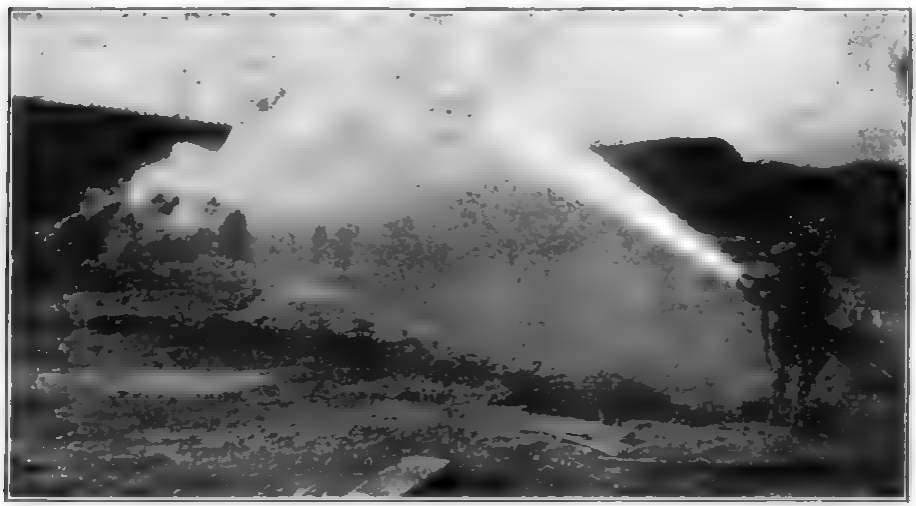
Mrs. Moroni was "lucky." But the important thing is that she knew gold-bearing ore when she saw it. She knew the language of the rocks. How many people would recognize valuable ore if they should stumble across it? — not to mention a few hundred of the lesser-known minerals of modern industry, which often lie under-foot or just below the surface.

Gold Found Everywhere

Gold, symbol of wealth and power through the ages, is more widely distributed than most of us realize. Most of our supply today comes from Alaska and three states: California, Colorado and South Dakota. But the yellow treasure is an important mineral of Arizona, Idaho, Nevada, Utah and many other states.

Many nuggets of dull-colored but almost pure gold, smelted from ore by nature's intense fires, have been picked up in the mountains, in river beds, in placer diggings. It will profit any man who hikes, hunts or travels widely to study the appearance of gold seams in quartz and other mother or "matrix" ores. Many a jeweler's window and curio shop displays gold in some form, as do all museums.

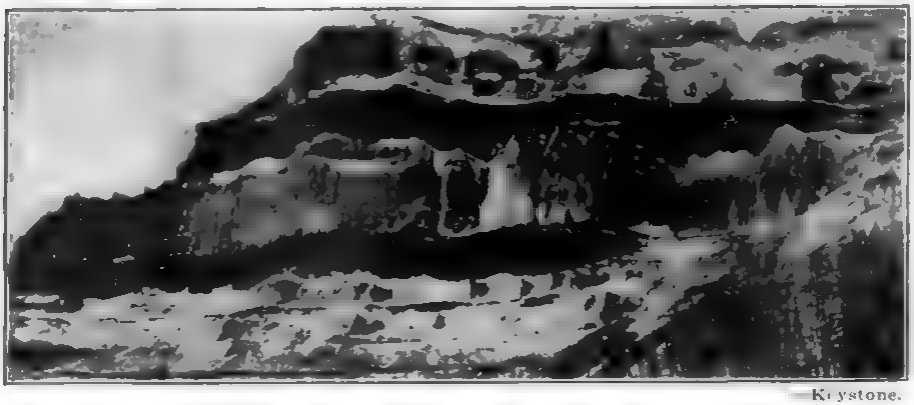
Gold has a standard value of slightly over $20.67 a Troy ounce. But several minerals are far more valuable for the same volume. Platinum brings four or five times as much. Black diamonds, which look and feel like cinders and are the toughest substance known, being widely used for cutting points



—Keystone

Where there is "pay dirt" and no stream to wash the gravel, a powerful hose is substituted. This is called placer mining, and here is shown a placer in operation on the Yukon.

Any Man's Coal Mine for the Taking



Keystone.

The coal in these exposed veins at Nenana, Alaska, awaits only the digging to bring a fortune! Valueless now, railways will some day make it accessible to civilization.

of rock drills and tools, bring $25 to $150 per carat. The latter price, for the hardest "carbonadoes" without flaws, is 1,100 times the price of the same volume of gold!

America's Only Diamond Mine

In Pike County, Arkansas, there is a volcanic "pipe," or filled crater, similar to diamond-bearing pipes of South Africa, which has yielded both white and black gems. It was about 25 years ago that John Huddlestone, a farmer near Murfreesboro, Arkansas, sat in the shade of a pine tree, recovering from a fever. He looked idly at the ground—and suddenly he had an attack of another kind of a fever. He picked up a stone and carried it home.

His wife always laughed at his habit of bringing home queer-looking rocks. But this time John saddled his mule for a trip to town. While mounting he spied another of the odd-looking stones, and dropped it into his pocket.

In town he turned them over to a jeweler. A few days later the report came from New York that they were real diamonds, finer than many South African gems. He sold his holdings for over $40,000, and sparklers up to 6½ carats have been taken from the only diamond mine in the United States. But the total output has been small. In the country today there are about *four billion* dollars' worth of diamonds, a total weight of about 5,500 pounds or 2¾ tons. A large part of this has come from the South African diggings.

$5,454,000 a Pound for Diamonds

There probably are other such deposits left by nature's laboratories, in which volcanic heat and inconceivably high pressures have converted pure carbon into partially-crystallized black diamonds, or into pure white sparklers. Steel-white gems from South Africa bring up to $3,000 per carat. This is only $5,454,000 a pound! If a meteorite should ever land in your back yard, you might find some diamonds in its nickel-iron mass. Many of these heavenly visitors have carried tiny diamonds, so microscopic that two of the largest would scarcely cover a pinhead.

Rough diamonds look much like ordinary sea-beach pebbles. Single gems of value have been picked up in states bordering the Appalachians, from Georgia and Alabama to Virginia. Lucky—and sharp-eyed—folk have also found valuable gems in Wisconsin, Michigan, Indiana, Ohio, California, Idaho, Montana and other states. Even the off-color gems and those with bad flaws have great value as industrial "bortz," for drilling, grinding and other uses. Two or three dozen of these larger crystals, usually eight-sided, may be worth $6,000 or more for such every-day purposes.

Dr. George Kunz, gem expert of Tiffany & Company, relates that from his earliest

boyhood he has had a passion for "pretty stones." At the age of fourteen he began collecting mineral specimens of all kinds. Finally, when he had accumulated some 4,000 pieces, weighing two tons, he felt impelled to part with his collection.

Although it brought only $400, he had "the thrill that comes once in a lifetime" by being at once accepted as a recognized mineralogist. In the decades since then he has popularized many stones formerly valueless, such as topaz, tourmaline, opal, agate, coral, sunstone. A zircon today, for example, brings up to $2,000 or more if perfect.

Jewels as Paving Stones

Value, of course, depends upon demand (if any). In Russia there is little surplus wealth for such luxuries as jewels. Not long ago the State lapidary works at Sverdlov, Siberia, sold immense stocks of uncut topaz, beryl, jasper, malachite, and other semi-precious stones, at the price of ordinary stone. The city used the jewels in paving its streets and for filling in around new wharves!

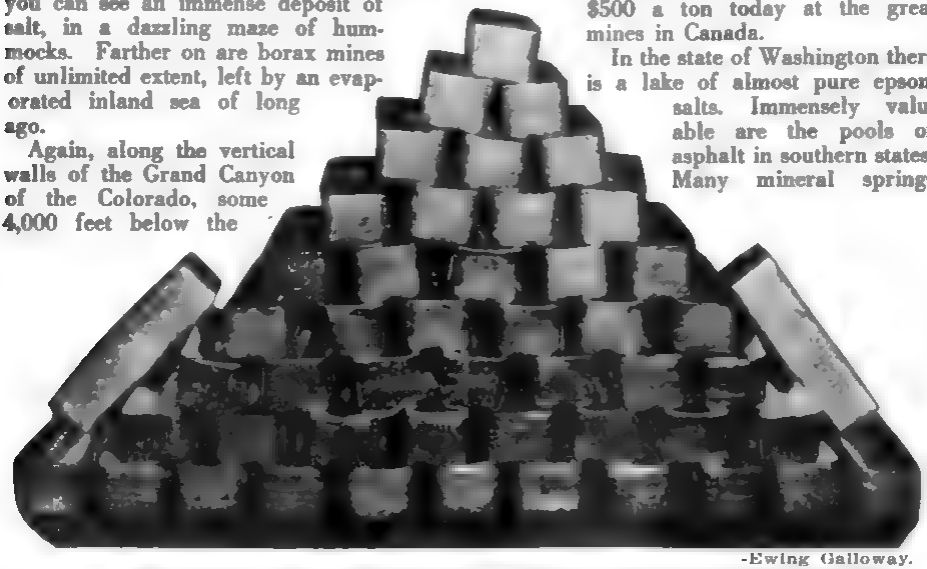
Few regions are lacking in deposits of some kind, above or below the surface. Standing on top of the Funeral Range, along the rim of California's Death Valley desert, you can see an immense deposit of salt, in a dazzling maze of hummocks. Farther on are borax mines of unlimited extent, left by an evaporated inland sea of long ago.

Again, along the vertical walls of the Grand Canyon of the Colorado, some 4,000 feet below the top, you can see long seams of the finest asbestos fibers. Some day they will be worth fortunes, for there is no high-quality asbestos in this country, where demand is enormous for this curious mineral that can be woven into clothing and is unaffected by heat, time or chemicals. Even ordinary commercial grades bring over $500 a ton today at the great mines in Canada.

In the state of Washington there is a lake of almost pure epsom salts. Immensely valuable are the pools of asphalt in southern states. Many mineral springs

© Ewing Galloway

Silver is frequently found in a free state, running in veins of pure metal. This crystal is a wonderful nugget of natural silver.



-Ewing Galloway.

Some eagle-eyed prospector saw the first gleams of ore which led to this fortune in silver! These ingots, cast in form for shipping, weigh 1,040 troy ounces—value $50,000.00.

—Ewing Galloway.

Taken near a big dredging enterprise on the Condoto River in western Colombia, South America, this picture shows native women mining for platinum. The water contains so much platinum that fish cannot live in it, and one can taste platinum in the fogs which are frequent in those parts. Forty-two ounces a week is considered big production.

carry valuable minerals in solution. A concern was recently formed to evaporate the water of the Dead Sea in Palestine. When all of the pure potash, soda, bromine and other salts and chemicals are recovered, it is estimated that the ancient sea will have given up something like 1,200 billion dollars' worth of wealth!

Scientific prospecting apparatus promises to simplify greatly the future location of underground treasures. Successful location of salt domes in the Gulf region, almost invariably associated with oil pools, is developing a new science of exploration by use of dynamite explosions and seismograph recorders of the resulting earth-waves. These indicate the depth and position of rock and other strata, and the salt domes.

Treasure-Hunting by Machine

Some of the larger oil and mineral concerns are experimenting with torsion balances, electric, radio, magnetic and other methods of prospecting without digging. So far even the best of these will not show whether paying quantities are present. The U. S. Bureau of Mines is engaged in testing several devices where ore deposits have already been blocked out and the operation of each device can be checked.

If you have a likely deposit of anything, it will usually be cheaper to obtain expert assistance than attempt to sink a shaft or spend money in other development. Universities, mining engineers, mineralogists and other specialists may save you much unnecessary expense. Once a deposit is found, tested and proved, you will have ample opportunity to invest in equipment, mining, storing, transporting, marketing, and so on. There are some gold and other mines today which cannot be operated at a profit. Yet there are others, some abandoned, which are being rendered profitable by improved machinery and processes.

From year to year the value of our mineral and quarrying output steadily increases. It is now over six billion dollars annually, with half as much more from petroleum and its products. Since 1880 we have dug from the earth beneath this country over a hundred billion dollars' worth of metallic and non-metallic minerals.

The future will see many new deposits discovered and developed. There is a very strong demand for mercury, magnesite, and many other minerals now imported at growing prices. Watch out for treasures which Mother Earth may have hidden under your feet! But don't put your money in a hole in the ground, until you know what's coming out.

Soviet Clock is Made from Growing Flowers

IN THE botanical gardens of Sokolniki, Russia, there stands a unique floral clock which is not only ornamental, but which keeps accurate time as well. It stands twice as high as a man and is fashioned from living flowers built around a wooden framework. The emblem of Soviet Russia, a star and sickle with a sheaf of wheat, may be seen worked into the arch above the clock face. An interesting feature of the clock is that the year, the month and the day are worked in flowers directly under the minute hand in the picture. If you can read Russian, you will be able to tell the exact day and minute when the photograph was taken.

This clock is made from growing flowers. Note the day of the month and year shown directly under the tip of the minute hand.

CLOTHES WOVEN FROM WEEDS

A USEFUL purpose for palmetto, a nuisance growth found in Florida and other southern states, has at last been found. It is woven into hats, lamp shades, pillows, animal toys, and even into dresses as shown in the picture. The tissue fiber that grows around the palmetto bud is carefully removed and peeled into a sheet, which is used in weaving the various items. The fiber is very tough and durable.

The dress shown above is woven from fibers of palmetto, a weed growth of the semi-tropics. The toy dog is also fashioned from palmetto fiber.

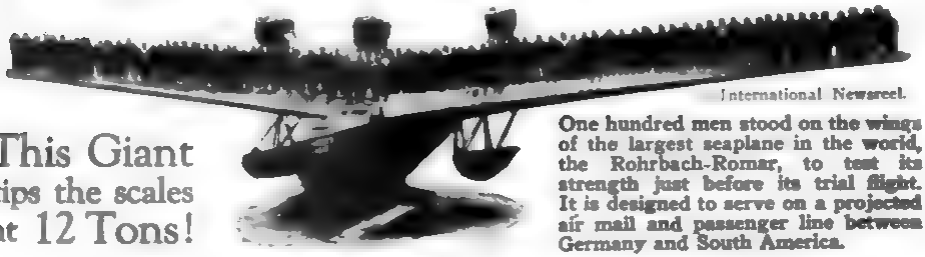
CIGAR LIGHTER CONTAINS WATCH

HERE'S the latest ingenious novelty in the form of a midget watch built into the case of a cigarette lighter. By comparison with the fingers of a man's hand it will be observed that the tiny watch is only three-quarters of an inch wide, yet despite its small proportions it keeps accurate time. Considerable ingenuity was required in fitting the springs of the watch into the case so that the mechanism did not interfere with the operation of the lighter. The watch is protected by a glass crystal and in all other respects its operation is identical with that of "man size" watches.

The watch is wound by a stem extending through the case. It was built in his spare time by a New York watchmaker.

GIANTS *of the*

HIGH above the clouds they skim—man-made birds with hearts of steel, their streaking exhausts blazing new highways in the heavens. Those first airplanes had but one engine and could carry but one man—today the multi-motored ships carry as many as 30 passengers. In the air the ships of today are safer, stronger, and infinitely more graceful than the fragile mechanism of wood and linen which the Wright brothers trundled out on the field at Kitty Hawk.

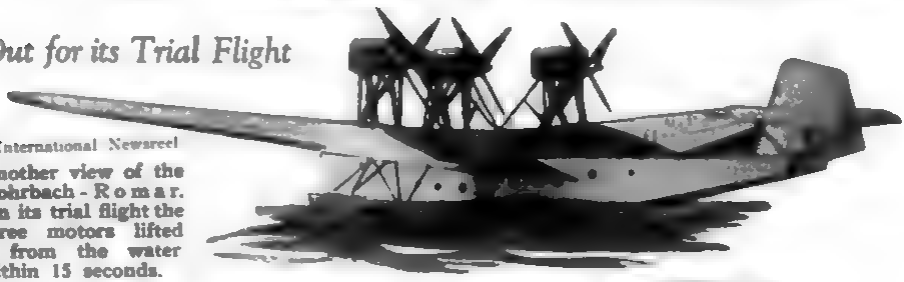


—International Newsreel

This Giant tips the scales at 12 Tons!

One hundred men stood on the wings of the largest seaplane in the world, the Rohrbach-Romar, to test its strength just before its trial flight. It is designed to serve on a projected air mail and passenger line between Germany and South America.

Out for its Trial Flight



—International Newsreel

Another view of the Rohrbach - Romar. On its trial flight the three motors lifted it from the water within 15 seconds.

Dreadnaught of the Air

Carries Two Machine Guns in Turret

—International Newsreel

A revolving armor-plated turret carrying two machine guns is built into the nose of this immense flying battleship. The guns can be swung completely around by the gunner. The plane can travel at 150 miles an hour all day long. It is a twin-engined monoplane recently purchased by the French government from a firm in France.

—Ewing Galloway.

Pilot's seat of a modern airplane.

AIR!

The largest Airplane in the world—the British "Inflexible," all-metal Monoplane

The Giant in Flight

Nothing small about this ship! In fact, you can look the world over without finding a larger one. It is the Beardmore "Inflexible." When loaded for flight, it weighs 30,000 lbs., and half of this weight is "pay load." The landing wheels are eight feet in diameter. Instead of a tail skid, it carries a wheel which swings on a pivot, like a caster. To the uninitiated it might seem that the huge ship could never rise from the ground, but the picture at the left shows the plane in the air. Far from being sluggish, she is extremely efficient in flight, having servo rudders and ailerons.

Ford Plane Nestles Under Wing of "*Inflexible*"

Some idea of the tremendous wing spread of the "Inflexible" may be gained by comparing it with the Ford all-metal monoplane, one of the largest airplanes of American manufacture. The "Inflexible" has a wing spread of 150 feet. The Ford tri-motor is shown to scale alongside the huge British ship.

FLYING Forts of the

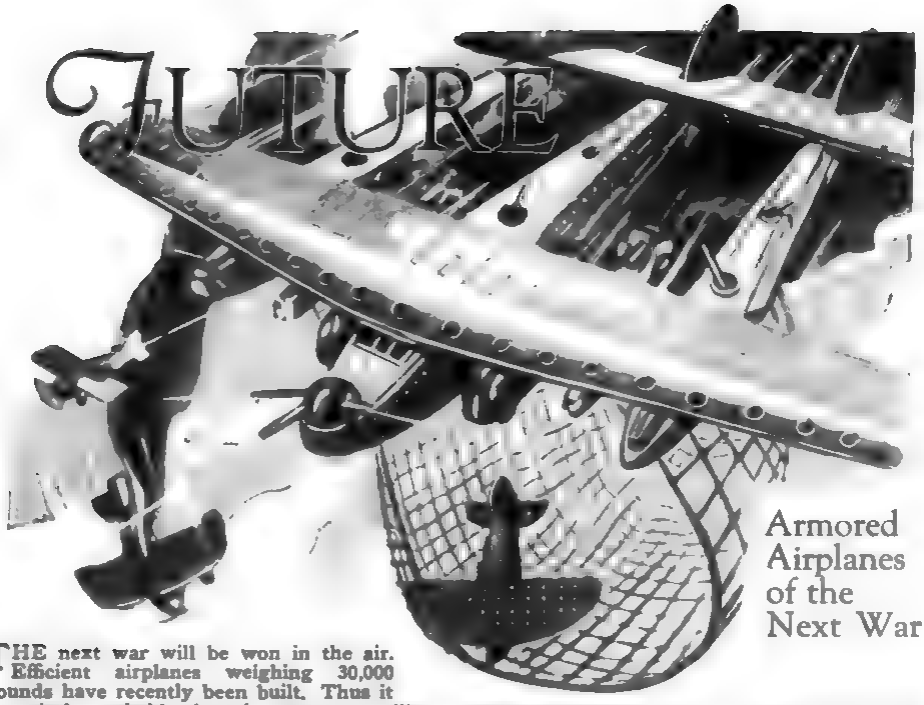
By MAJOR H. H. ARNOLD
Assistant Chief American Air Service During the World War

WHAT will the fighting airplanes of tomorrow be like? Will wars of the future be fought between armored battleships of the sky? Major Arnold, one of America's best known authorities on military aeronautics, here makes some interesting predictions as to the part airplanes will play in wars to come.

AT THE present time we have no precedents for the results which may be expected from aircraft in warfare other than that obtained in the World war. We know that the airplanes of today are much more efficient and have greater speeds and radii of action than the airplanes of 1918. We have maneuvers, demonstrations and experiments to govern our prognostications, but in the end the role which the airplane will take is problematical.

Military aircraft is usually divided into four classes, observation, pursuit, bombardment and attack. The observation secures information. The bombardment destroys objects by means of the bombs which the planes carry. Attack aviation destroys and delays troops and destroys lightly constructed ground installations. Pursuit, by driving down hostile air-

The flying warship of the future, in addition to being protected by armor plate, will probably be fitted for dropping smoke curtains to obscure the movements of ground troops.



Armored Airplanes of the Next War

THE next war will be won in the air. Efficient airplanes weighing 30,000 pounds have recently been built. Thus it is entirely probable that the next war will see huge armor-plated machines such as this take the air over enemy territory, equipped with cannons and gas bombs, and possessing protective devices such as an electrified drag-net suspended from the fuselages which will have the power of crippling enemy aircraft by setting fire to their wings.

craft, furnishes protection to both ground and air organizations from aerial attack. Such are the types of aircraft with which the supreme commander of the future will protect his own troops and destroy and delay those of the enemy.

Observation aviation will be used from the day war is declared in all future operations. Observers will be sent beyond the sphere of action of the armies and navies to determine the location, strength and composition of hostile forces. The information which they secure will be sent back by radio or given verbally upon the return of the mission.

Staff officers and even the commanders themselves will take the air to get first-hand information regarding their own or hostile troops. Some of these planes will undoubtedly be shot down, but these aerial eyes will be so effective that practically all troop movements will be made at night.

Observation planes will operate from altitudes of two or three hundred feet above the ground to heights of ten or twelve thousand feet. High above those planes there will be the photographing planes taking pictures of features of military value.

Taking Photos 250 Miles Away!

New developments in photography are making their appearance daily. The newspapers recently told of a camera which could take pictures of objects 100 to 250 miles away. In order to work this camera, the airplane will have to climb to an altitude of 20,000 or more feet. Hovering over New York, the airman will be able to take a picture of Philadelphia or Boston! Such a proceeding is almost beyond human comprehension but it is a present day possibility.

Then again, there is that device which enables the aerial photographer to take photographs on the darkest nights. The airman takes a large bomb of flash-light powder and trails it behind the plane. When he

is over the place of which he desires to take a picture, the flash light powder is ignited. A flame results which has an illuminating intensity of several hundred thousand candle power. The ground beneath is illuminated for a fraction of a second as light as day. The picture is taken.

The observation planes of today are far advanced over those of the World war. These planes have a high speed of around 140 miles an hour, can climb to 18,000 or 20,000 feet and have sufficient gasoline in their tanks to enable the aviators to fly for a distance of 300 miles and return. Each plane carries two machine guns for shooting to the front and two more for shooting to the flanks and rear. They also are equipped so that in case of need they can carry ten 18 pound bombs. These machines have been developed in the last two years.

Pursuit planes are ordinarily single seaters. The planes themselves are very maneuverable and have an exceedingly rapid rate of climb. The tendency now is to have large formations which fly so placed that each can protect the others. Individual combat will take place only after the first onslaught.

Pursuit planes now have a high speed of close to 170 miles an hour, a ceiling of above 20,000 feet and can cruise for over five hours.

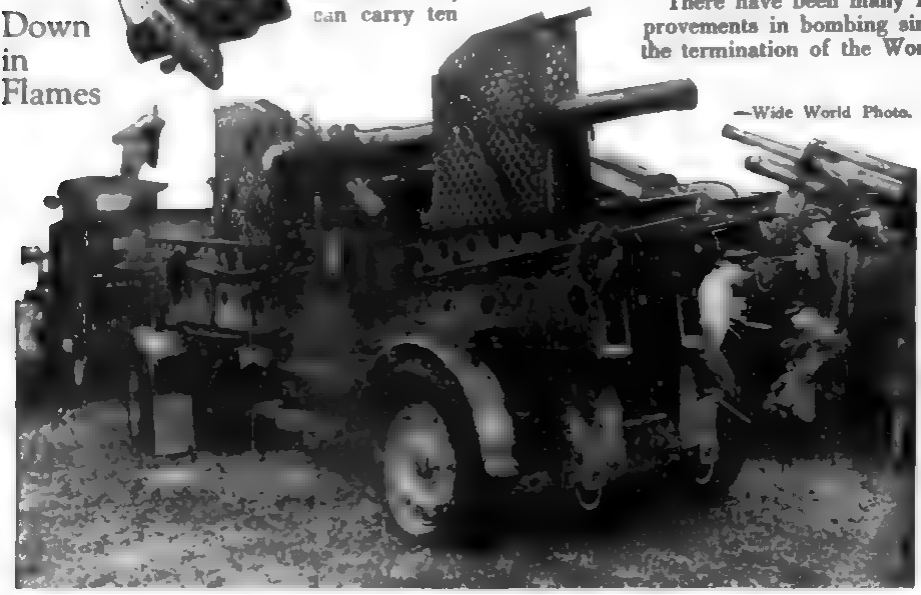
Airplanes Attack Doughboys

Attack aviation is a new development since the World war. Planes especially designed are now used for that purpose. The theory of attack aviation is that the planes will fly along close to the ground, make their attack as a surprise and then make their getaway. These planes are equipped with machine guns and bombs. They fly along in echelons and as the first echelon opens its machine gun fire from a range of about a thousand yards, the following echelons fly over the target and drop bombs.

There have been many improvements in bombing since the termination of the World

Down in Flames

—Wide World Photo.



Just as the airplane has been improved, so have the ground defenses been developed. Here is shown a remarkably effective new anti-aircraft gun of the U. S. Army which fires a three-inch shell. Such guns will bring down in flames the flying forts of future wars.

During the World War airplanes swooped over the trenches and riddled the occupants with machine gun bullets. Using present-day machines, a pair of attacking planes could annihilate a regiment of doughboys!

war. The planes have been improved materially. Bombing planes now have speeds of over 120 miles an hour. The bomb sights have been improved to such an extent that the dropping of a bomb on a target has been reduced to almost mathematical certainty. Bombing pilots now claim that the new sights are so accurate that they prefer a moving target to a still one.

The bombs used during the World war weighed from 15 to 600 pounds. The Germans dropped some toward the latter part weighing about 1,000 pounds. Airplanes have since that time taken bombs weighing 4,000 pounds into the air and dropped them. Experience has shown, however, that two 2,000 pound bombs will cause greater destruction than one 4,000 pounder.

Along with the improvement in airplanes and their accessories have come the development of smokes and gases. In spite of the fact that the present rules of warfare prohibit the use of poisonous gases, their manufacture will probably always be continued.

A combination of aircraft and gas makes a fearful weapon. A few years ago a device was perfected whereby a smoke curtain could be projected from an airplane in flight. The gas used was emitted from a nozzle at the rear of the plane in small particles which oxidized as they struck the air and fell toward the ground.

Such a curtain could shield the movements of troops on the ground while marching into position or while preparing for attack. It could absolutely prevent approaching aircraft from being seen while they made their attack with machine guns and bombs.

Airplanes Lay Smoke Screens

The modern method of laying these smoke screens is to use a fast maneuverable airplane for that purpose. A pursuit or attack plane can approach the position which it is desired to screen in a dive with a speed of 200 or more miles an hour. Each plane lays a screen of about a mile in length. It takes about 20 seconds or less for the plane to lay its screen. Thus it will be under fire from any particular point for less than 10 seconds. There is small probability of a plane traveling at that speed getting hit, especially when it is considered that these screens will nearly always be laid when least expected by the men on the ground.

Airplanes with Gas Bombs Can Destroy Cities

Just for point of argument, suppose that a nation strong in aircraft and which had not agreed to banning poisonous gases went to war. Then either from airdromes or from airplane carriers, it launched fifty or more airplanes equipped to lay gas screens, against the financial or governmental centers of its opponent.

Imagine the horrible awakening of the inhabitants of the cities when they became aware of the fact that they were marooned by a curtain of, say, mustard gas. Perhaps the capital and the financial districts would be entirely cut off from the rest of the country. No one could enter or leave without a rubber suit and there are few of them in existence.

The gas being heavy would sink into the subways and basements and stay in place for a week or ten days. In the meantime other planes might repeat the dose. If certain vital congested areas were chosen for the attack and a deadly gas utilized, it is almost beyond visualizing just what would happen.

Most assuredly soldiers of the future have a complicated system of warfare to cope with. The number of aircraft comprising the aerial arm of military nations is constantly increasing and the performance of the planes themselves is constantly improving. One of the surest methods of bringing down planes is to concentrate a pattern of bullets in and around the plane.

Some authorities visualize the soldiers of the future as veritable walking arsenals. There will be many more machine guns available for anti-aircraft use. Close formations will be discarded during daylight hours. Every advantage will be taken to conceal the whereabouts of troops from the prying eyes of the airmen. All this will increase the hardships and discomforts of the foot soldiers. However, the doughboy will trudge along the road just the same in spite of the tin helmet, gas mask, added ammunition, increased weight of machine rifle and the discomforts of night marches, for when a nation puts its soul in a war, it marches on to victory or defeat with no pity for the individual.

—Wide World Photo.

Enough high explosives to lay waste a fair-sized city can be carried by the huge planes of the present day. The aerial bombs shown in the picture are just a light load for a 15 ton plane!

Do You Know That a Waterspout is Fresh Water?

—Keystone.

This waterspout, photographed on Lake Superior, is formed from fresh water condensed from the atmosphere, not from water sucked up through its funnel.

HAVEN'T you always believed that waterspouts are caused by tornados sucking up water through their funnels? Contrary to popular belief, waterspouts are formed from fresh water, condensed from the atmosphere by the rapid whirling motion of the tornado-like clouds. A waterspout is very dangerous to fishing boats and other small craft. Cases are on record where large ocean-going liners have been forced to limp into port, their plates battered from conflict with a waterspout. The danger of running into a spout lies in the fact that contact with the moving column of water is likely to shatter it so that its tremendous weight crashes on the deck. Waterspouts occur in widely distributed parts of the globe. They are also observed frequently on large inland bodies of water such as the Great Lakes.

FINS ON FEET HELP SWIMMERS

Aluminum plates shaped into fins and strapped to the feet as shown in the photograph have been developed to give greater speed to swimmers. In practice they are found to increase the driving power of a swimmer's legs considerably.

SIDE-CAR CARRIES BABY

This bicycle side-car is made from an old wash-tub.

ADAPTING the motorcycle side-car idea, a Viennese mechanic took an abandoned wash-tub and an old wheel and fashioned a side carriage for his bicycle large enough to carry his infant son. The side-car is detachable at will merely by loosening the two rods which secure it to the bicycle frame. In addition to carrying a light weight passenger, the side-car also aids in balancing.

FLYING for Science

by CAPTAIN SIR HUBERT WILKINS
Famous Polar Explorer

WILL the Wilkins Expedition to the South Pole succeed in gathering data that will make it possible to foretell the weather changes of the world months in advance? Captain Wilkins explains in this article the scientific purpose behind his flight to the bottom of the world, where he is even now preparing for his hop across the ice wastes of Antarctica.

TOO MUCH glamour is attached to the efforts of men who, with modern paraphernalia such as well-equipped airplanes attempt to follow in hours the paths which it took explorers of the past many weary months to hack out, that the real purpose of the present-day aerial expeditions to the polar regions is lost sight of.

The layman reads that so and so has accomplished a thrilling flight from one continent to another across the wastes of ice which for centuries have challenged human travel. He sighs, and remarks that it is interesting if true, and that is all it means to him. Possibly his imagination has been surfeited with tales of publicity seeking persons who, after the first few epochal test flights across the oceans, have kept the front pages of the newspapers alive with tragic news of loss of life to the end that Mr. General Public has come to class all men who fly to far places in airplanes either as "nuts" or as sporting playboys bent on a pleasure jaunt for no definite reason. Possibly by pointing out the purpose of the proposed trip which Lieut. Eielson and myself are making to the Antarctic I can set at rest the doubts of the lay mind as to the need for this kind of work, and dispel the thought that "all this Arctic" exploration is not productive of practical results.

Weather Secrets Learned

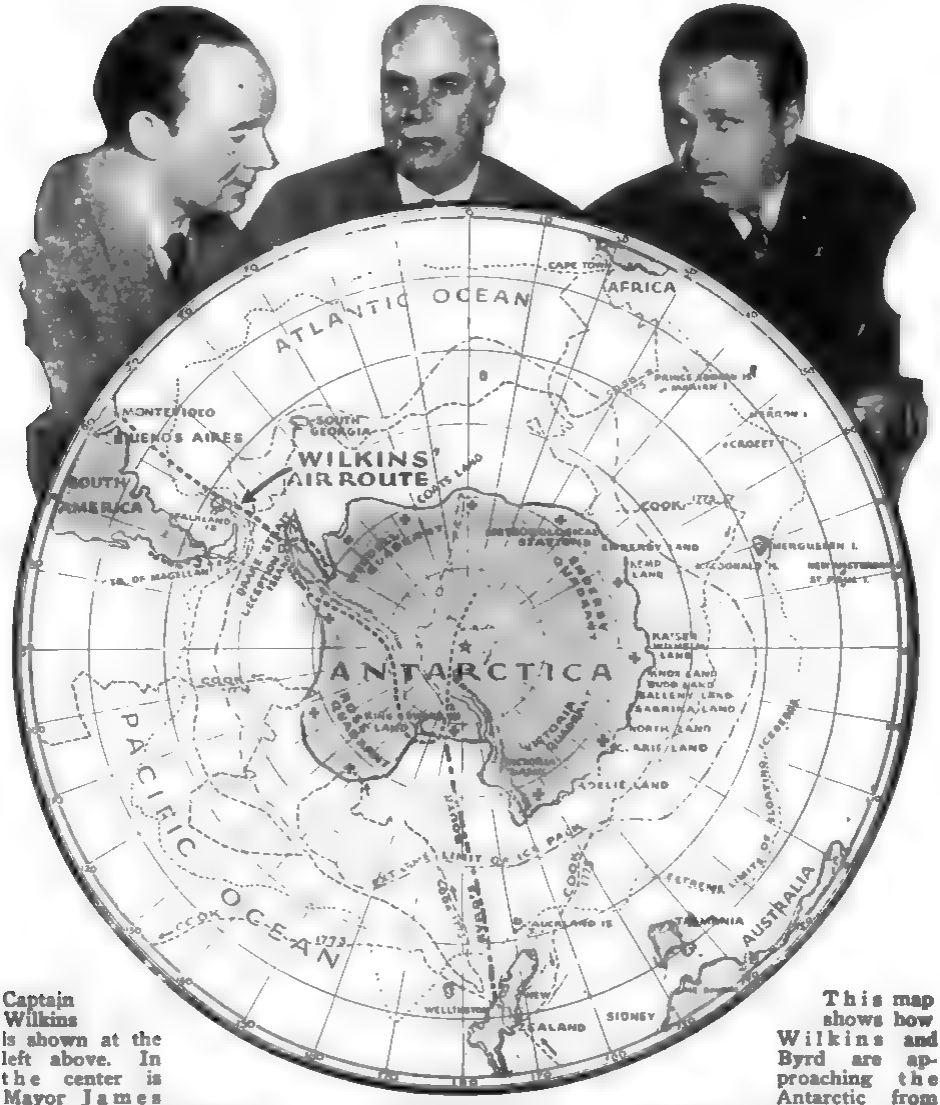
Rather, these expeditions by airplane into the unknown vastness of ice and six-month days are of vast importance to the world of business. They are of immense value to the farmer, to railroads, to shipping owners. There is not a business or a livelihood which does not profit by the things learned on a successful flight of exploration and meteorological observation into the unknown icelands. On such flights weather secrets are found which will eventually enable us to tell in advance what sort of weather will prevail in the temperate zones.

It seems a far stretch of the imagination to say that what happens today in the Antarctic ice cap may affect the pocketbook of the United States farmer three months from now, doesn't it? Yet such is the case. If the reason is known for the existence of certain winds which blow toward the Straits of Magellan from the ice cap, their

CAMERA SEXTANT TAKES FLAWLESS SIGHTS

Wilkins will take with him on his spectacular South Pole dash one of Commander Pierce's Sextant Cameras. Instead of trying to catch a sight of the sun and bring it down to a horizon on an old-fashioned sextant, Wilkins will photograph an accurate "reading" of the sun in its relation to the horizon merely by the operation of a lever when the sun is in the "finder," and thus he can have an exact record of his position on the earth's surface. The sextant camera is shown in the photo above.

at the SOUTH POLE



Captain Wilkins is shown at the left above. In the center is Mayor James Rolph of San Francisco, for which city one of Wilkins' airplanes is named. At the right is George Hearst, one of the backers of the flight.

—International Newsreel.

This map shows how Wilkins and Byrd are approaching the Antarctic from opposite sides of the globe. The meteorological stations shown on the rim of the ice-continent will be established to collect scientific data.

Fighting the Antarctic!

UMBRELLA tents are used by all Polar explorers. These tents are stowed compactly aboard an airplane and folded in the same manner as an umbrella. Breath condensers worn as shown in the drawing will also be used to conserve the water exhaled by the lungs. Alpine ropes are used in crossing the antarctic ice, in which huge crevasses occur, sometimes 200 feet deep!

frequency can be determined with relative ease. Their frequency being known and the cycles of their violence having been determined, it is not hard to forecast what winds will blow over the earth in that section of the world, or what their rain bearing content will be. Nor is it difficult to approximate the effect these winds will have on the winds which blow across the great American middle west—over wheat fields of Kansas and the Dakotas, for instance.

The weather conditions on the surface of this globe are as subject to scientific analysis as are the chemical equations in the making of currant jelly. The only reason that it is easier to figure out and forecast the behavior of currant jelly is because the whole process is under observation and conditions can be seen when "on the make." The weather would be just as predictable if the whole surface of the world were under observation instead of a small belt in the north and south temperate zones. The farmer could more accurately plant his crop, prices could be more nearly stabilized, and business as a whole would move without its present ups and downs.

Correcting the Geographies

For the purpose of determining whether there was land in the unexplored area between Alaska and Spitzbergen, Lieut. C. Ben Eielson and myself flew over the territory. The fact that land was not found where it was thought to have existed gives scientists new facts to work on in predicting the weather. They can now go ahead with their theories, knowing the area is nothing but water and ice, and construct weather maps which will be fairly accurate in foretelling weather in the United States. I do not mean to say by this statement that this can be done because of the flight we made—that merely eliminated one of two conjectures as to the geography of the Arctic. It made known facts concerning a hitherto unexplored area. Civilization will have profited by the adventure. Nothing more need be said to justify the work.

Now the same unknown conditions exist in the South Polar region. No aerial expeditions have been made over the Antarctic ice cap, which, being an area as large as the United States and subject to the most

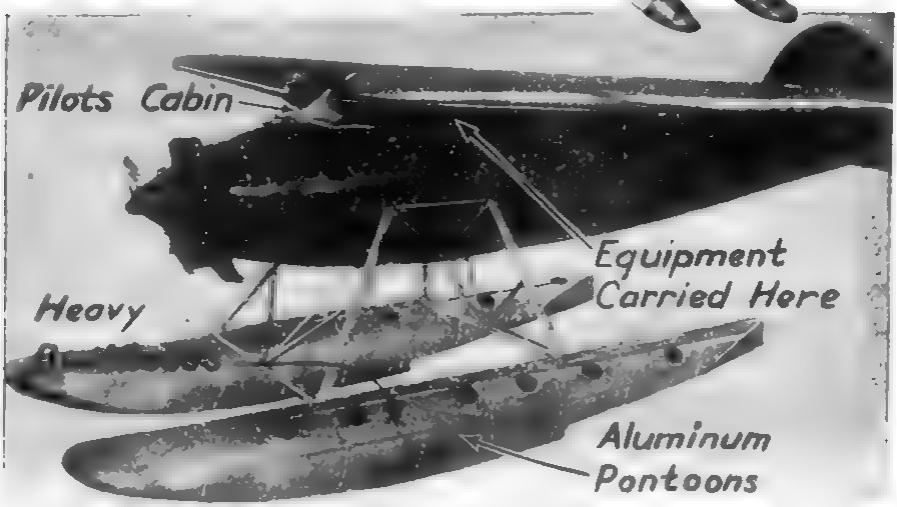
violent storms, is the fountainhead for many of the winds which wander the world and affect the weather. Our expedition, coming at the same time that the eyes of the world are fastened upon the expeditions at the South Pole, is in no way the "race" that popular supposition would make it. The work that Eielson and I hope to do is supplementary to that good work undertaken by Byrd.

Will Establish Weather Stations

It is our purpose eventually to maintain and establish twelve permanent meteorological weather stations around the South Polar ice rim. As you will see from the map, it is our intention to proceed, after arriving by steamer at Montevideo, to a point in West Antarctica due south to Deception Island, a distance of some 500 miles. From this point, at which we will establish a base, we will fly over Foyn and Charcot land, endeavoring to determine whether the much debated Davis strait exists, and what relation the igneous rock on Grahams land may have to the horizontally stratified coal bearing shales found on the borders of the Ross Sea.

Thence we will fly along the debated Antarctic coast line, proving its existence and what relation the conditions thereon might have to weather phenomena. It is possible we will meet with Byrd, who will approach King Edward Land from the antipodes.

Certain it is, however, that our purpose in flying to the South Pole is not that of a high-spirited holiday. We have in sight a definite service of great value to all the world, and sincerely hope our mission will bear the fruits we expect it to. If our love for adventure, exploration and ability to meet with Arctic conditions enables us to emerge from the unknown wilderness of white dimness of "down under," the preliminary work for our meteorological plan will have been accomplished. The airplane, being a spectacular means of travel, will enable us to do a year's work in a day, and the labor of the present day explorer is lightened a thousand-fold because of the new developments of science we have at hand. Thus science conquers the south Arctic for science's own sake!



Companion plane to the Lockheed-Vega which carried Wilkins and Eielson over the Arctic wastes, this pontoon-equipped airplane will augment the flying equipment of the Wilkins Antarctic Expedition. Note the extra heavy, non-collapsible bulkheaded pontoons, under which wheels can be placed for handling on ice as shown in the top photo.

Camera Catches Burglar Looting Poor Box

—International Newsreel

WHEN Father Cassidy of St. Joseph's Church in New York began to suspect that the church poor box was being systematically looted, he called in the aid of modern science to capture the thief. An electric camera was connected with the poor box so that the pilferer would take his own picture in the act of committing the theft, at the same time ringing an alarm bell.

The picture shows the photograph taken by the thief-catching camera, which was the means of convicting the burglar. Father Cassidy, Detective Mahoney, and the prisoner, Charles Callan, are shown in the upper photo, reading from left to right. Patrolman James O'Connell is the inventor of the crime-detecting camera.

The device has proved so effective that police departments in several large cities will soon adopt it.

TWENTY-FOOT MOTORBOAT FOR OCEAN TRAVEL

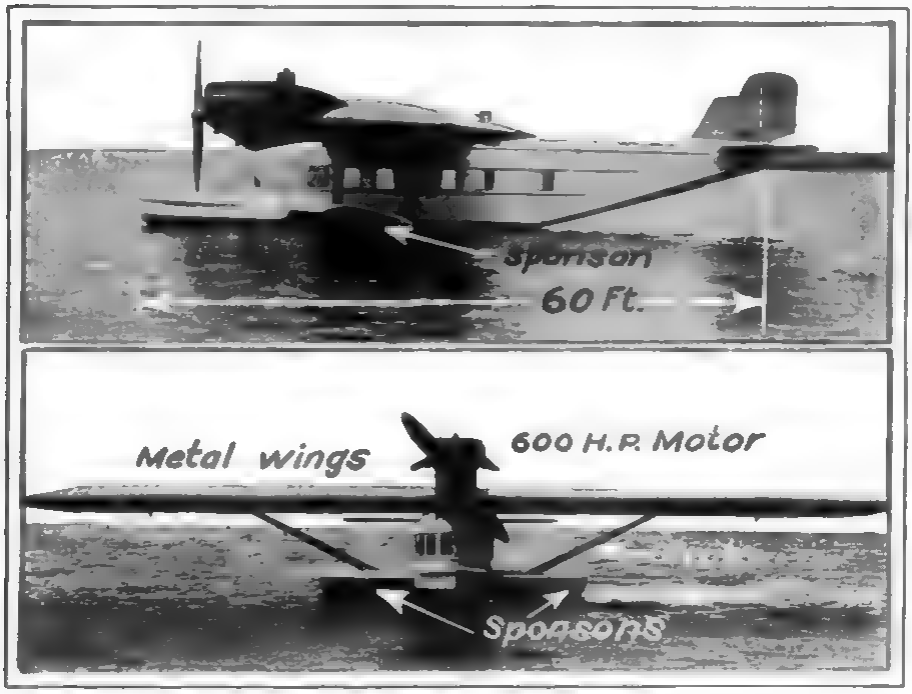
An unusual type of all-metal motorboat has been designed by a German engineer for ocean-going travel. The boat is completely covered over to protect occupants from heavy seas and is so buoyant as to be practically unsinkable in the roughest weather.

The cabin is in the center of the boat, with accommodations for two passengers. Entrance is gained through a sliding waterproof doorway at the end of the raised deck. Power is furnished by a gasoline engine. The boat has a length of 20 feet and a beam of 4 feet. A good idea of its size may be gained by comparing it with the figure of the inventor on the deck.

Passengers' quarters are comfortable though not overly spacious. Provision is made for carrying supplies so that the boat will be self-sustaining for a two months' cruise. The photograph was taken on Lake Constance, where the designer is making test runs of his craft.

Designer of all-metal motorboat is shown with his craft.

10-Passenger Hydroplane Has Unusual Design



A NEW type of hydroplane in which the sponsons, the pontoon-like projections alongside the hull, serve the double purpose of giving the ship buoyancy in the water and lifting power in the air, has been developed by German engineers for service on rivers and inland lakes. It is equipped with a 600 horsepower engine mounted in front of the upper wing above the pilot's cabin.

The roomy cabin has accommodations for ten passengers besides the crew. As the photo shows, the construction of the hydroplane affords unusually clear vision from the cabin, there being no projecting underwing to obscure the pilot's view. The ship can make 100 miles an hour.

MACHINE TESTS BEARING METALS

WEARING qualities of various metals and alloys are scientifically tested on a special machine developed by the U. S. Bureau of Standards, shown in the photograph at the right. It consists of a specially built lathe with various accessories which measure the number of miles of service bearings of different types will give before they wear out. Through use of this machine Uncle Sam is able to tell automobile manufacturers just what metals they should use in making durable bearings. Bearings are actually worn out in the testing lathe under conditions closely approximating those they must meet in service.

Electing Presidents by

HERE'S a New York miss casting her vote by machine. The voter pulls a lever and enters the booth. Choices on the candidates are made by setting small markers. These stamp the ballot and the machine records the vote.

—International Newsreel.

New Mechanical "Ticket" Quickly Counts Votes

PRESIDENTIAL elections this year have shown graphically the tremendous part played by modern machinery to accomplish the people's choice of a national executive. Votes are, in many large cities, registered by machines that prevent "stuffing the ballots," adding machines click to count the millions of manual ballots, telegraph wires hum with the news, and the radio and giant printing presses broadcast the results.

The vast machinery of election must register quickly and honestly the votes of millions. These votes in turn name the electoral colleges which this year have a total vote of 531. The second Monday in January the state electoral colleges meet, and a majority—266 votes—is necessary to name the President. It would be possible for 17 million voters to choose one candidate to the opponents 8 million, and still have the majorities choice defeated by one electoral vote. Cleveland, in 1888, defeated Harrison in the number of votes, yet Harrison was elected by a majority of the electoral vote.

Then, next February on the second Wednesday, Congress meets to canvass the electoral vote and announce the people's choice. Four months are required by the great machinery for an election to determine finally the next President of these United States.

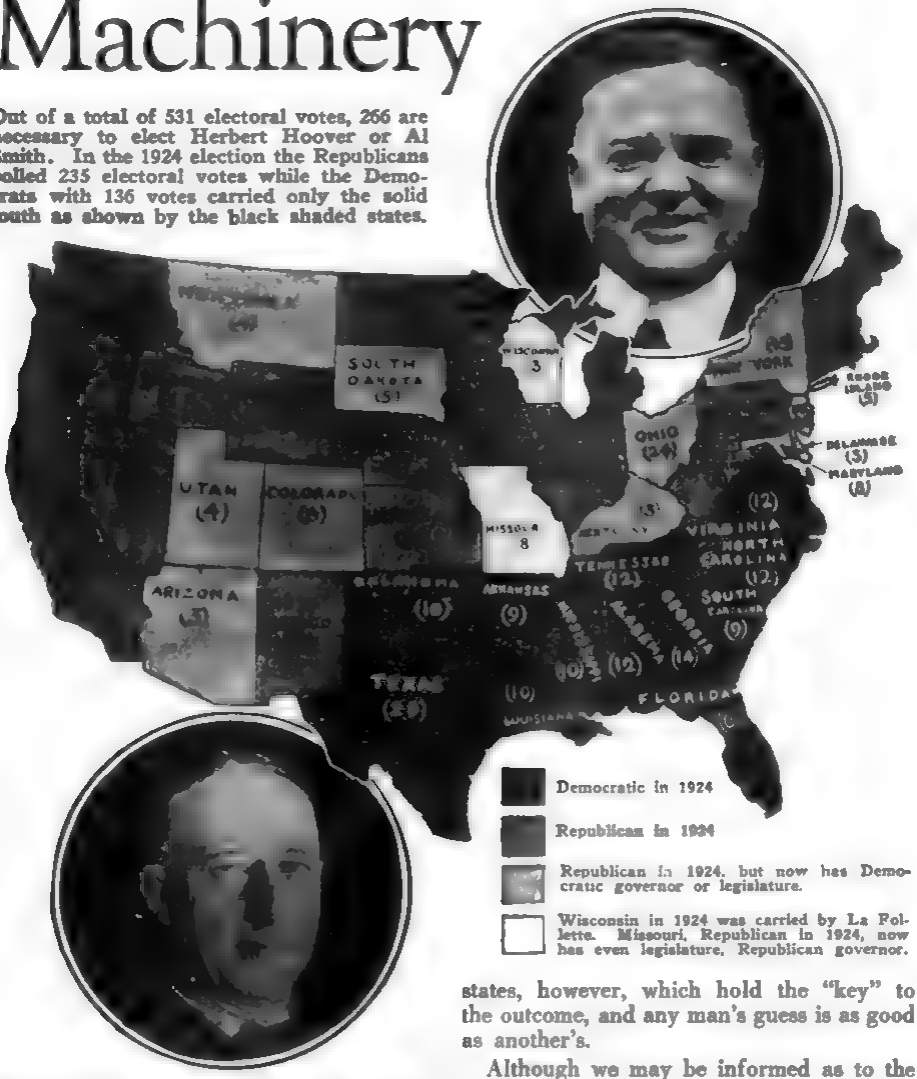
Forecasting the results of this year's election by comparing the figures of votes in 1924 with the possibilities of 1928 returns has been a popular sport during the fall months. The map shows how it is done.

First a list of the states is made, showing the number of electoral votes to which each commonwealth is entitled (see numerals on map.) Then, consulting the results of 1924, a fair estimate of the votes each party will get is made. The varying shade on the map illustrates how the states voted in 1924, as well as their present party standings. The lightest shade indicates a state that was Republican in 1924, but which is now under a Democratic governor or legislature—and these doubtful states number eleven.

Definitely Republican are twenty-two states, while only twelve are definitely Democrat, according to the political map. The undecided states, then, will play a big part in the election. Of these New York is one,

Machinery

Out of a total of 531 electoral votes, 266 are necessary to elect Herbert Hoover or Al Smith. In the 1924 election the Republicans polled 235 electoral votes while the Democrats with 136 votes carried only the solid south as shown by the black shaded states.



with 45 electoral votes and a decided leaning toward the Democratic candidate, despite Republican legislature. All these considerations had their effect on the forecasts.

Generally the map of the electoral college votes will forecast with a great degree of certainty, the results of a national election. This year great interest is aroused from the fact that the map of the electoral college votes looks like a puzzle. There are eleven states, however, which hold the "key" to the outcome, and any man's guess is as good as another's.

Although we may be informed as to the indicated outcome while voting is taking place, and, thanks to the voting machines, we may be enlightened as to what the country as a whole decides on the Presidential question, there is still a possibility that a popular choice can be defeated in the electoral college vote. Never in the history of the United States have two such able men been matched as candidates for the highest office in the land.

FOOTBALL *Mechanically*

Gridiron gladiators toughen their muscles and develop their timing and teamwork through the use of these machines devised by college coaches.

—International Newsreel

Above—This rolling boudoir, drinking fountain and combined field shower is in use by the Army at West Point, and shows the effect of modern sanitation on football, doing away with the germs!

—International Newsreel.

At right—Developing holding power in a line is an important task for a coach. New York "U" uses this upholstered spring sandwich to turn the trick. The men get the muscle and the springs get the grief!

—P & A Photo.

Boxes in staggered series are used at Northwestern to train the legs in open field running. This device is especially effective in developing a stabbing high-knee run which sheds all but the fastest flying tackles.

Fundamentals Taught

Get in there, Grange!

Hit 'em low!

Garland Grange, brother of "Red," the famous Galloping Ghost of Illinois, gives French and Schultz, also of Illinois, some tough bucking. The shoulder harness is meant to develop line plunging power in backs. It is another variation of the bucking horses and carriages, but is said to build faster action in the backfield as it allows more active play of the muscles.

The old familiar dummy is taking a lot of licking these days! Latest developments in "cloth cluck" devices include a dummy hung from a block on a cable, which enables the dummy to be moved to simulate a running figure. Hard hitting and keen timing are brought to perfection by the use of this rig.

International Newsreel.

To develop the muscles of the thigh, calves and ankles for a quick driving getaway, Fordham coaches have built this training bucker. The coach sits astride the "bucking dolly" as it is called, and can observe first hand the fine points of a lineman's work.

Enter Your Coo-Coo Contraption *in* Contest *No.* 2 — WIN A PRIZE *With Your* DUMB-BELL DEVICE

Anybody can design a Coo-Coo Contraption—here's your chance to get paid for it! Read the rules, study the sample shown, and send in the "nuttiest" idea you can set down on paper. You don't have to be an artist—anybody can compete.

COO-COO CONTRAPTION concoctors have been responding warmly to Modern Mechanics Magazine's offer of substantial cash prizes for the best dumb-bell devices with goofy gadgets submitted in the prize contest announced in the November issue. Contributions have been pouring steadily into the office and announcement of winners will be made soon after the close of Contest No. 1, for which entries must be received on or before December 1, 1928.

Coo-Coo Contraptions Contest No. 2 will end on January 1, 1929. Entries received after this date will automatically be entered in the next monthly contest. Modern Mechanics will offer prizes for the best contraptions every month until further notice.

FIFTY DOLLARS IN PRIZES

Fifty dollars in prizes will be distributed each month among the seven winners in the Coo-Coo Contraptions Contest, as follows:

First Prize $25.00
Second Prize.....$10.00
Five Third Prizes each $3.00

Address your manuscripts to Coo-Coo Contraptions Editor, Contest No. 2, Modern Mechanics Magazine, Robbinsdale, Minn. Contest No. 2 closes January 1, 1929. Manuscripts received after this date will be entered in Contest No. 3.

The coffee stirrer on the opposite page is a good sample of a Coo-Coo Contraption which contestants may study to advantage. Unlike most inventions, the test applied is not how simple and practical it is, but how complicated and funny it may be. For instance, it is readily seen that the coffee stirrer is a more or less workable device, but the market for coffee stirrers is as yet so undeveloped that the inventor might very well starve to death before disposing of his patent rights. Modern Mechanics will pay real money every month for such inventions.

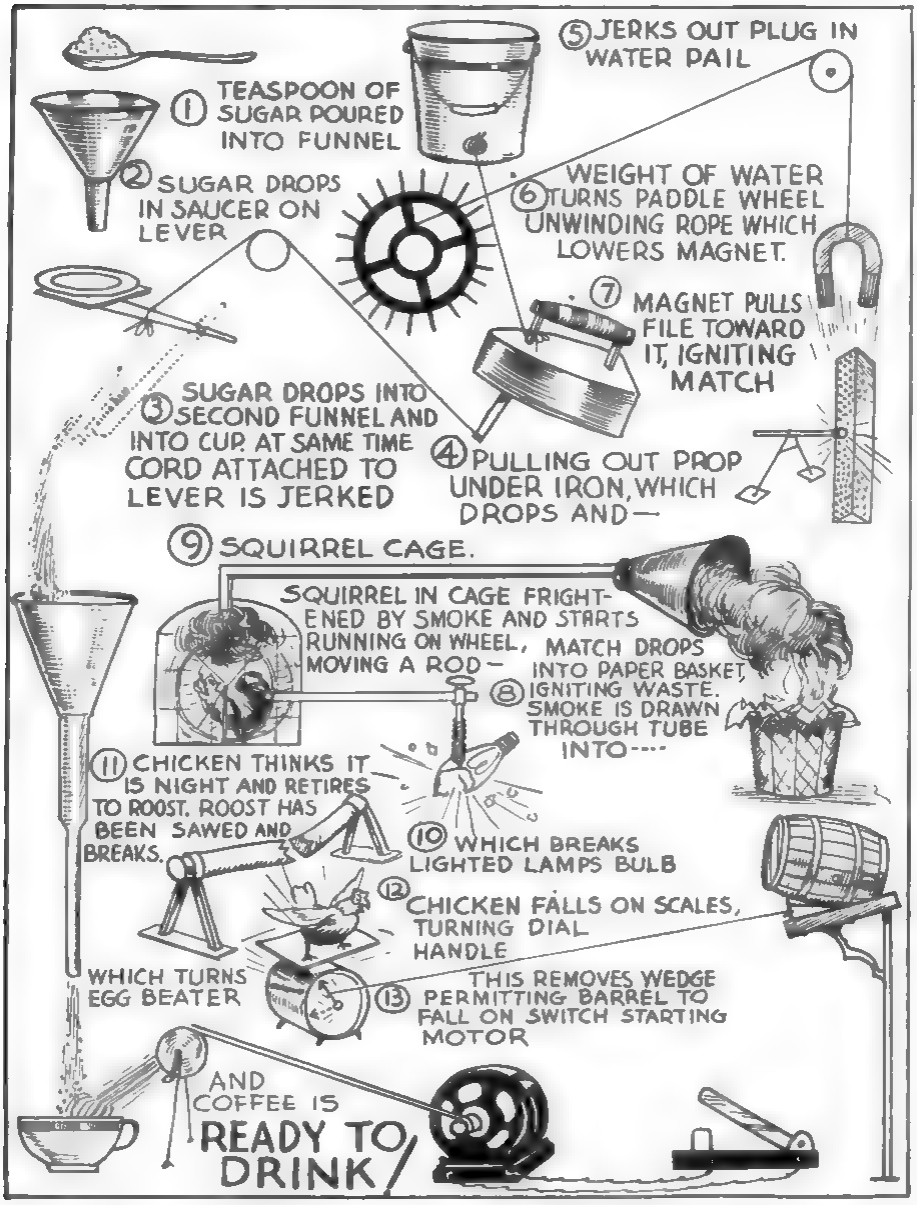
It is not necessary to send a finished diagram of your idea in order to win a prize. All that is needed is a clear explanation telling how your device works so that our artist can make a picture of it. Prizes will be awarded on a basis of originality of idea and humor shown in working it out. The funnier your contraption, the better chance it has of winning a prize.

Prize-winners will be announced and diagrams of the winning contraptions published in the earliest possible issue after the close of the contest. Manuscripts will not be returned; if you wish to preserve your Coo-Coo Contraption, be sure to keep a copy of it. Prizes totalling $50 will be divided between the seven lucky contestants. Decision of the judges will in all cases be final. In case of a tie for any of the prizes, the full amount will be paid to each of the tying contestants.

Remember, make your contraption as funny as you know how. It can serve any purpose, useful or useless, from cranking a Ford to ringing a doorbell. Study the sample contraption on the opposite page, think up a better one, and send it along to Coo-Coo Contraptions Editor, Contest No. 2, Modern Mechanics Magazine, Robbinsdale, Minn.

Announcement of prize winners will be made in this magazine as soon as possible after the closing date of the contest. You do not have to be a subscriber to Modern Mechanics to compete. Contestants should bear in mind that the contraptions must not have too many working parts, since all the details must be pictured in a one-page drawing.

Coo-Coo Coffee Stirrer *for* Restaurants



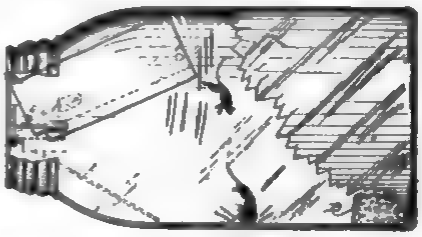
Start at No. 1 and figure out why nobody ever thought of this simple device before!

PATENTS *Nutty* or *Novel*

INVENTORS of the contraptions shown on this page have applied to the U. S. Patent Office for the sole right to manufacture their inventions. Readers may decide for themselves whether the devices are likely to make fortunes for their designers.

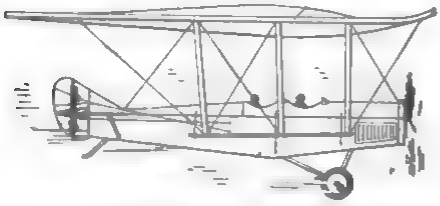
COME ON, CLOUDBURST

The exhausting labor of holding an umbrella in the hand when breasting an April shower, is done away with by the unique holder shown above. A belt is worn around the waist and the umbrella handle anchored to it. Thus the two hands are left free for purposes of argument, self-protection, or what have you?



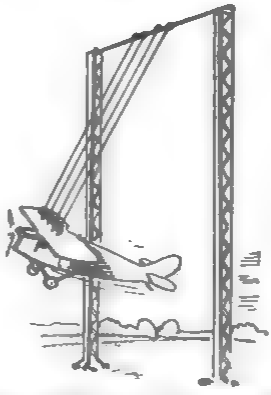
GLASS MOUSETRAP

Every mouse entering this rodents' Palace of Sweets, sets the trap for the next nibbler. These mason jar mousetraps are expected to play to capacity houses in every city in the land before long. Killing is done by drowning.



SOMETHING NEW IN AIRPLANES

The unusual wing arrangement of this new airplane is supposed to make it extremely stable in the air. The upper wing is fully four times as long as the ordinary wing, and has a thickness of about two feet. It covers the entire length of the plane, giving the effect of a roof overhead. Of course, the pilot in the cockpit can't see much that is going on above him—but think how useful a landing net the wing would be in catching aviators shaken loose from the cockpit while looping the loop!



CABLE BRAKE FOR AIRPLANE

An airplane landing device that works! All the pilot has to do is to fly between the uprights and hook his wing into the cables swinging from the crosspiece—then his plane slows down like a pendulum. If he misses his mark—well in this game one strike is out!

Radio Ear Phones Help Deaf to Hear Sermons

EVER since the early days of radio broadcasting religious services have been sent out on the air via the microphone, but not until recently did it occur to anyone that the radio could be used to make the pastor's sermon audible to deaf members of the congregation. A Boston pastor reserved two special pews for the use of hard-of-hearing folks, and in them he installed sets of radio ear phones. As a result the deaf churchgoers were able to understand the sermon as well as anybody. In the photo at the right two of the phones are shown in use.

—International Newsreel

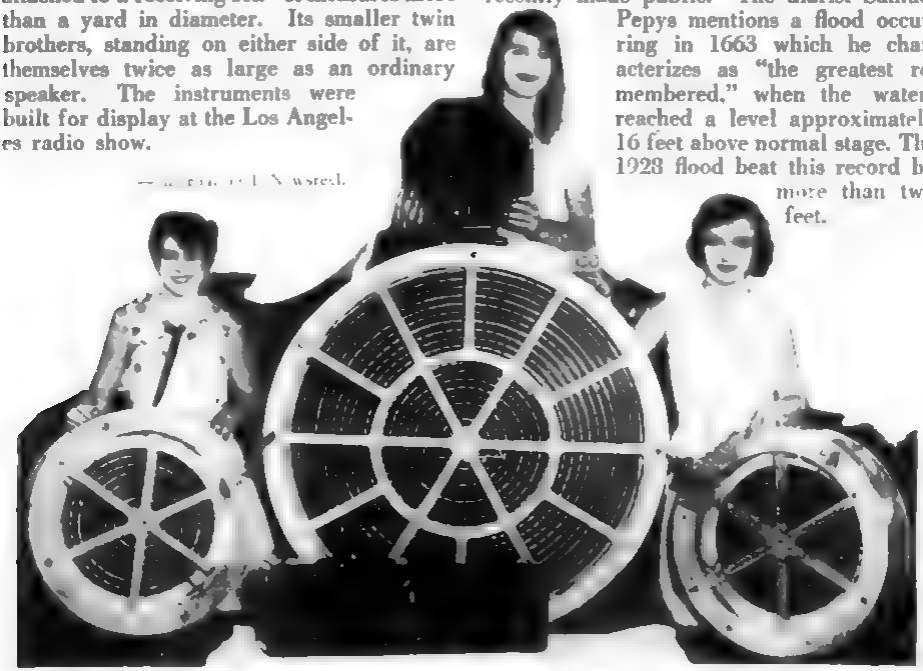
RADIO LOUD SPEAKER CAN BE HEARD THREE MILES!

THE voice of the radio can be heard for more than three miles when the giant loud speaker shown in the picture below is attached to a receiving set. It measures more than a yard in diameter. Its smaller twin brothers, standing on either side of it, are themselves twice as large as an ordinary speaker. The instruments were built for display at the Los Angeles radio show.

—International Newsreel

THAMES FLOOD RECORDS BROKEN

ALL HIGH-WATER records of the Thames river at London were broken by floods of January, 1928, according to data recently made public. The diarist Samuel Pepys mentions a flood occurring in 1663 which he characterizes as "the greatest remembered," when the waters reached a level approximately 16 feet above normal stage. The 1928 flood beat this record by more than two feet.



These giant loud speakers were displayed at the recent radio show in Los Angeles. Compare the size of the center giant with the standard speaker in the girl's hand.

A Startling EXPOSE *of*

To Monte Carlo they come, a steady stream of fortunehunters bent on the futile business of bucking the machines of the gambler—all of them unbeatable in the long run, even when fairly operated. The photograph shows a bit of action at the roulette table inside the Casino.

WHEN a man steps into a gambling house with the intention of bucking the professional gambler's devices, he hasn't one chance in a hundred of getting a square run for his money. The crooked methods used by cheats are explained by the author of this article, himself a retired gambler who for obvious reasons prefers to remain anonymous.

"NEVER give the sucker an even break."

This little motto should be emblazoned over the door of every gambling house, just as the "welcome" sign is woven into the doormat.

To the gambling house keeper, every person who enters is a sucker. The more money he has the bigger sucker he is, and the more pains will be taken to cheat him, that he may go away broke after having paid handsomely for his fling.

Science and mechanics have been brought into play, but always on the side of the professional gambler. Skilled mechanics, electricians, chemists and mathematicians have spent much time and energy in arranging things so that the gambling house keeper will never lose.

As a professional gambler who has retired from the business after fifteen years of practice, I say this:

"There is only one way to beat a gambling house. Wait until after it has closed for the night. Get a jimmy and break in. Take a can of nitroglycerin and blow the

Crooked Gambling Devices

safe. Steal what money is in it. Get away without being caught—and you have beaten the gambling house."

Perhaps the game having the largest vogue among ordinary people is dice, in one of its various forms. Of these varieties, craps is the most widely played. In every gambling house there is a crap table with its elaborate layout. It is a simple system for the player.

Shooting Crooked Craps

The player begins. He takes the dice, puts down five dollars, and bets that he will pass. He throws the dice. If he passes he wins. Again he may pass. And yet again. But now he has won enough. A pair of dice loaded so that he will throw craps is handed to him. On each throw of the dice the player must toss them out of his own reach, so far away that the stick man must reach them and hand them back to him. It is thus easy enough for the gambler to switch dice.

Then, in a larger house, perhaps there is the magnet under the table. A good magnet will work through an inch of wood, glass or any other material of which the table is made. The dice for use in this game have been especially loaded with metal, so that they are fair dice unless attracted by magnet.

In this game, the magnet is controlled by a button, usually at the foot of the banker of the game. If there is a heavy bet on a certain point, six for instance, the banker steps on the button, the dice come up with a seven, and the house has won again.

In a large gambling house in Chicago is a table with a metal base underneath the felt covering. It looks like an ordinary pool table. But the moment the juice is turned on, the whole table becomes a magnet.

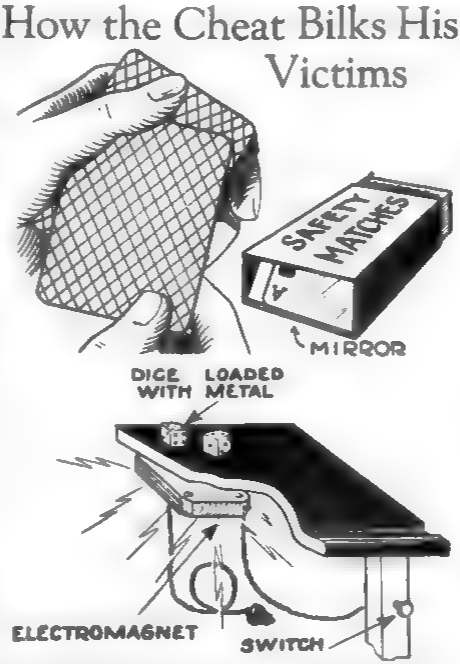
A year or so ago I was present at a small game in progress at this table. The average bet was ten dollars, and a good crowd was at the table. A rich cabaret proprietor wandered in. He started betting fifty dollars a throw. The dice were fair and he made a few passes.

He won five hundred dollars, and began to joke with the banker, asking why it was so easy to win money. The dealer merely smiled. A few minutes later the juice began to flow into the magnet every time the cabaret proprietor bet.

He laughed at his change of luck and began to double the amounts of his bets. Still he lost. This kept up for hours until the cabaret man was broke, having lost six thousand dollars. And he never even suspected that he was being cheated.

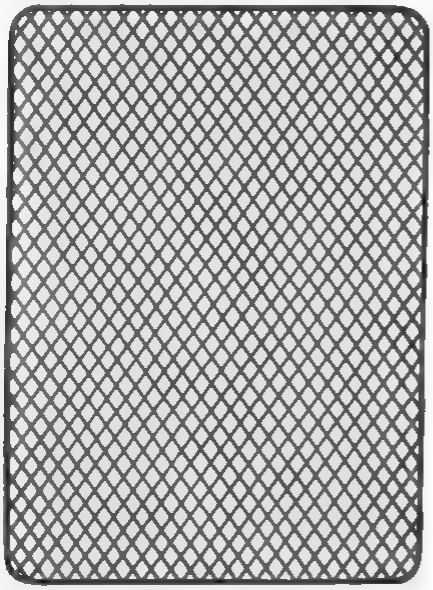
Often the magnet under the table is in the shape of a money drawer.

Another clever little device used by the cheaters is the Chinese dice box. This is not much used in gambling houses, but is found around hotels where dice is played. In most states there are



The match-box mirror is commonly used in poker playing. The electromagnet is used in crooked dice games.

Just a Plain Card—Until



Viewed Thru Eye Shade

The top card looks innocent enough. But when tinted spectacles are worn by the gambler, a colored figure, invisible to the naked eye, identifies the card for him.

laws against gambling, and to protect the players against police interference, it is necessary that the rattle of the dice should not be heard.

Here is where the Chinese box comes in. It is a simple circular box, with a cover. The dice never leave it, as it is lined with felt, and the dice shaking in it make no noise. But the cubes are always under the control of the owner of the box.

Around the upper edge of the box is a little ridge, so placed that if the dice are shaken with a certain motion, they will make exactly one quarter turn—no less, no more.

The owner puts the dice in, figures up what combinations are on each side of the dice, and shakes the box until he gets the particular combination that will win. The others, not knowing the motion necessary to control the dice, will lose.

But for cleverness, nothing beats the "Tap Dice." These are loaded with mercury in such a way that a certain kind of tap will render them loaded, for instance, to throw seven almost every time. Until they are tapped by the operator they are perfectly fair dice.

At cards, one stands equally poor chances of winning.

First, there are the devices by which the dealer may read every card dealt to the others, as he deals them face down. Most famous of these is the match box reflector, an innocent looking safety match box, but containing a small mirror by which he sees the face of each card. Also, there is the ring reflector, or "Shiner," which is merely a signet ring with a shiny surface, often detachable, whereby he can see the cards as he deals.

Marked cards are another of the schemes used to cheat the sucker.

Roulette—"The Sucker's Game"

But roulette is where the big money is lost. A roulette wheel can't be beaten.

There is, in the first place, the "juice wheel," or electrically controlled wheel. All the little pockets in which the ball drops are of metal. There are 36 numbers on the layout, exclusive of the 0 and 00, which always are house numbers. All numbers are either black or red. One set of wires is run to the black pockets and another to the red. If a large amount is bet on a red number, the

operator pushes a button and the magnetic ball is drawn into a black pocket. If heavy betting is on the black, another button is pressed and the ball jumps into a red pocket.

A more simple device for cheating at roulette is the little rubber back which can be slipped into a pocket. It is a small piece of hard rubber the same color as the bottom of the pocket, and will kick out the ball if it drops in that pocket.

As a case in point, I remember a rich jeweler who entered a gambling house in Missouri. He played only roulette, and had a penchant for numbers twenty, seventeen and twelve. The operator of the wheel noticed that he placed heavy bets on these numbers almost exclusively, so stuck a little rubber in each of the pockets.

The jeweler lost a thousand dollars. The next night he came back and lost two thousand. The following night he came in and established a credit. The gambling house keeper cashed his check for the ten thousand. He lost that, betting on his pet three numbers almost entirely. When the ten thousand was gone he pleaded for more credit. Another check for three thousand was cashed. He lost that, and went away.

About an hour later the jeweler came back, whitefaced and disheveled. Turning on the owner of the house, he demanded:

"Give me back my checks. I'm ruined. My business is ruined. I'll be put out of business."

The owner laughed at him.

"That's too bad," he sneered, "if you couldn't afford to lose what you did you shouldn't have come in here. Nobody made you play the wheel."

"Perhaps not," the jeweler replied, "but if

A very common and easily read method of card marking is shown herewith. Note the varying positions of the braces on the bicycle. If you know where to look for the marks, it is easy to tell what cards your opponent holds in his hand. But unless suspicion is aroused nobody would suspect the cards of being crooked.

—Times Wide World.

In the Casino at Monte Carlo, shown above, all the gambling machines are "on the square." Even so, the house returns an immense profit to its owners—profits taken from over-confident folks who imagined they stood an even chance of winning.

you don't give me back those checks I'll go over to my hotel and blow my brains out."

The owner of the house was still unwilling to give him back the money he had cheated him out of, but his partner interceded, and the checks were torn up.

The Black Side of the Game

Most gamblers, however, are not so kind hearted. Many men have committed suicide over gambling losses. At Monte Carlo, the highest priced of all the gambling places in the world, there are on an average of two hundred suicides a year.

Even the lesser forms of gambling, such as spinning for heads and tails, put and take tops, and chuck luck, are not safe from the cheater.

A put and take top which can be controlled, is used by gamblers. It is so arranged that if it is twisted clockwise, as the ordinary person spins it, it will fall so that the spinner must "Put." But if spun counter-clockwise, as the cheater spins it, it always registers "Take."

A coin, beveled at the edges, can always be made to fall the way the cheater wants it to fall. If a half dollar, for instance, is beveled slightly above the "We" in "In God We Trust" on the coin, it will always fall tails when spun.

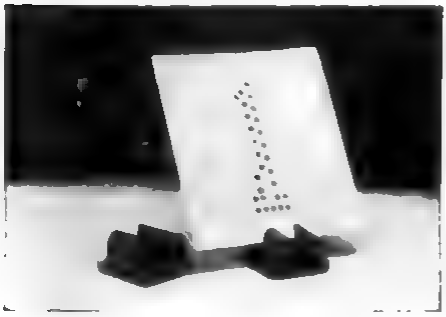
In chuck luck, the "old army game," where the betting is simply on numbers as they are registered on the three dice in the chuck luck cage, a magnet may be under the cage which can be turned on, and the dice always made to fall on a winning combination.

Many forms of the cheating at cards, dice, roulette, chuck luck and other games are well known and even the suckers have heard about them. But the gambling houses are thronged each night, workmen lose their salaries, wives gamble away their husbands' wages, widows lose their little nest eggs, each one hoping to augment his income. And the pathetic thing about it all is that none of them ever had a chance to win.

The sucker never gets an even break when he bucks the devices of the gambler!

Handy Devices *for the* Home Work Shop

By FRANK W. BENTLEY



CARD HOLDER

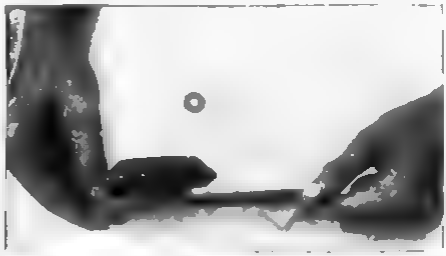
A GOOD many clever schemes are resorted to in making homemade devices to hold small display and marker cards. The above photo shows how a strip of old rubber felt-run salvaged from a junked car can be made into such holders with the help of a sharp pocket-knife. Cut the strip into inch lengths, and make a slanting cut for the card thru the channels of the strip.

TO UNLOCK THE PADLOCK

THE thin bar or slide over the key-hole of the average padlock is difficult to manipulate when wearing heavy gloves. Take the extreme end of an ordinary tobacco can cover and solder it to the bar as shown. It is then quite easy to push the bar over and hold it while inserting the key.

PASTE WORKING TOOL

THE ordinary white paste coming in soft tube containers is a good adhesive, but there is nothing ever convenient with which to apply and spread it. If considerable work is to be done with the paste, take apart a common letter clip as shown. One of the clip halves makes an excellent paddle-like affair with which to cut the paste from the mouth of the tube and to spread it quickly, evenly, and cleanly over the work.



PROTRACTOR MADE FROM RULE

A ROUGH and ready protractor for emergency use can be rigged up with a two-foot rule and a heavy shipping tag which is sufficiently accurate for ascertaining and comparing many angular faces when one does not happen to have better tools at hand. Punch the heavy wire dowel in the thin edge of the middle section of the rule thru one end of the tag, and close the halves so the pin will enter its hole in the opposite half. This holds the tag firmly, yet it can be turned on a rigid permanent center. The wide flat face of the closed rule can be used nicely to hold the parts under examination and comparison as shown. Record marks can be scribed with pencil on the tag along the inside edge of the rule halves.

STRANGE Music

NOT all the music of the world is produced by piano, violin, saxophone, or the familiar instruments of the orchestra. Every corner of the globe has its own favorite musical instrument, and though to American ears the beat of the tom-tom or the pinging of a savage harp is more weird than musical, nevertheless these queer devices represent the ultimate in melody to those who play them.

Father and son are partners in this two-piece Mongolian jazz band. They are using two different types of stringed instruments. The boy is using a device similar to a piano sounding board which is played by striking the taut wires with a hammer. The other instrument is plucked with the fingers like a banjo. These strolling musicians are a type found throughout Mongolia.

WAY back in the days of the cave men of Cro-Magnon some curious experimenter discovered that queer sounds could be produced by pounding on a tight skin with a stick—and thereafter he no doubt filled in the tedious hours by playing his own compositions until his desperate fellows cast him to the dinosaurs. Some of the instruments shown on this page are not much farther advanced than the primitive skin drum.

The Alpine Horn in Switzerland can be blown by one man, but two are usually required to carry it about. The sound carries for a long distance in the thin mountain air.

INSTRUMENTS *for Making*

The West African native at the right is playing one of the most primitive harps in the world. There are less than a dozen strings in the instrument and the music produced is necessarily very simple, but the natives have learned to manipulate it so that the music is wild and piercing.

In the world's oldest Orthodox Greek Monastery at Rilo Bulgaria, the monks are called to prayer by tapping a hollow wooden instrument with a wooden hammer. Various notes can be produced by striking the instrument in different places and by regulating the power behind the blow.

Somebody, way back in the beginning of time, blew through a length of cracked reed and the first wind instrument was born. These Siamese women are very clever in producing simple melodies with their bamboo flutes.

Photos by Keystone

PERILS of POLAR

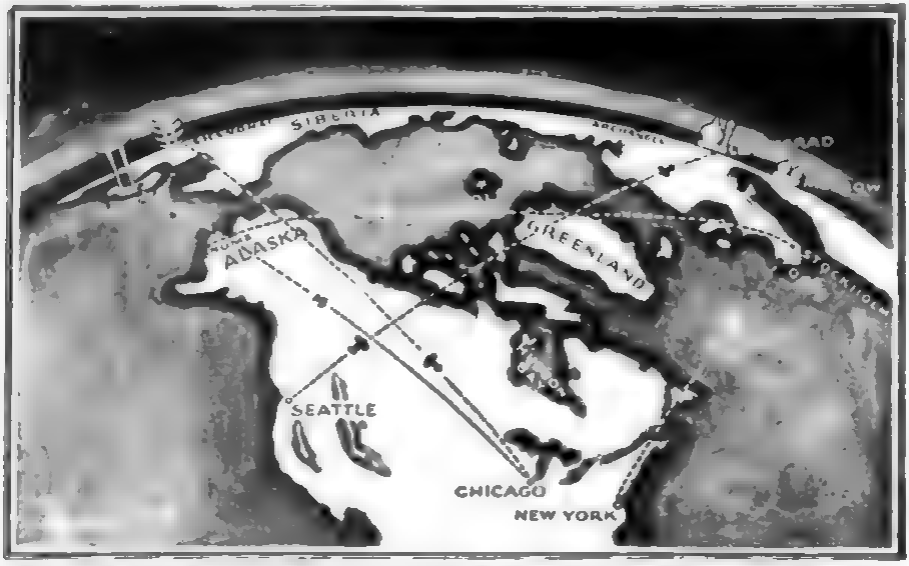
AVIATORS accustomed to flying over dry land in temperate climates have little conception of the dangers which must be faced by the pilot who flies the Arctic Circle. Lieutenant Eielson, one of the first men to fly the Arctic, here tells of the perils which meet aviators who fly frozen wastes.

COLD—bitter penetrating cold that strikes at the very vitals of an airplane motor, slowing it up or putting it out of operation entirely—that is perhaps the greatest danger confronting aviators who wing their way across the chill unexplored stretches of the Polar regions. There is no way of adequately describing the marrow-chilling quality of the winds at the top of the earth as they hit an airplane traveling at 150 miles an hour. The bitterness of them must be felt to be understood.

When Captain Sir Hubert Wilkins and I flew across the Arctic ocean last winter, the temperature was 48 degrees below zero. Our motor was bound with asbestos and shielded from the cold better than any engine I have ever seen. Yet after we had been in the air for about seven hours the motor began to sputter and miss. Cold was gripping it in its icy fingers—this in spite of the heat generated within the cylinders hundreds of times every minute.

Climb Warms Motor

Below us was open water, ice-cluttered—certain death for us if we were forced to come down. Our lives were in the keeping of our engine. And it was faltering, its pulse-beat growing irregular as the icy winds from the Pole chilled its stout heart.



Short cuts over the North Pole are graphically shown by the above map. Lieutenant Eielson predicts that these northern routes are destined to become regular arteries of transportation. An airplane can fly in a straight line, cutting hundreds of miles from the distance between Chicago and Tokio, for example. Note that the routes are almost entirely over land.

FLYING

by C. BEN EIELSON
Pilot of Wilkins Polar Planes

The Lockheed-Vega monoplane of Wilkins and Eielson is shown here taking off at the start of their flight from Pt. Barrow to Spitzbergen. Note the broad landing skiis.

Lieut. Eielson, shown above, will pilot the plane shown in the top picture across the desert waste of South Polar ice on the Wilkins Expedition.

I advanced the throttle full and went into a steep climb to warm the motor. Gradually it ceased to sputter; the explosions came more rhythmically until they blended in a full roar of power. At least thirty times during our 2,200 mile flight I was forced to repeat this engine-warming climb. After each climb I would side-slip down to a reasonable altitude and fly along for half an hour until the motor temperature had once more cooled to the danger point.

These climbs were very wasteful of gasoline. We used over 17 gallons per hour, where trans-Atlantic fliers averaged 11 gallons per hour with the same kind of engine. Some manufacturer should design a system of controlling the temperature of air-cooled motors while in flight.

Another difficult problem connected with Arctic flying is that of proper skis for the landing gear. I have used a dozen different kinds of skis, but have not yet found the ideal for all conditions. The problem of the landing gear is vitally important, for a large percentage of airplane crack-ups come from improper landing. This is especially true in the Arctic, where the wrong landing gear can easily tip a plane up on its nose or let it sink through a thin snow crust. The big, broad, long skis are advisable for landing on soft snow. Narrow, short skis offer less resistance to hard, icy surfaces. Skis may be of wood or metal, rigid or flexible, with grooved or flat bottoms. The only thing the aviator can do at present is to use a different ski for varying conditions.

Gasoline Stoves Warm Engines for Starting

Starting the airplane engine in cold weather is not at all difficult. It is covered with a canvas bag which fits it tightly and drapes down over a stove. Any type stove may be used, though the gasoline type with screened lamp to prevent fire, is usually preferred. After half an hour's heating the engine will start easily.

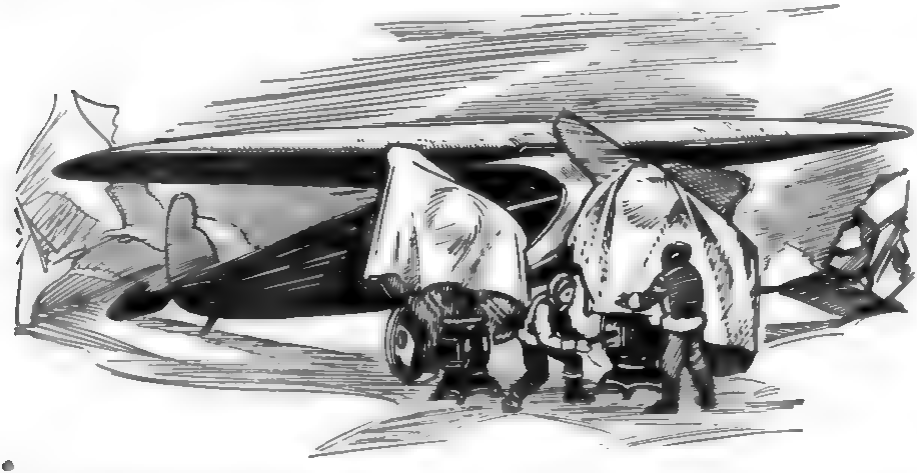
Arctic Flying in Winter

Five years ago nobody knew whether Arctic winter flying was at all practicable. In 1923 the United States Government gave me an experimental air mail route just south of the Arctic circle in Alaska. It was my job to determine whether or not it was possible to fly all winter in that frigid country. I used a De Havilland with a 400 horse-power Liberty engine.

At the time I began flying the northern mail route, it seemed a difficult and dangerous undertaking, but now I would rather fly in Alaska than in the United States. No insurmountable difficulties were met with, and today airplanes are as common in the interior of Alaska as dog teams, which they will some day replace. I used to fly in six hours the same route that dog teams took 22 days to cover.

It is my belief that before long we will see regular air service between America and Asia along the northern route. Most people do not realize it, but the very shortest route between Washington, D. C., and Tokio, Japan, lies across Alaska, and at no time in following this route, is the aviator more than fifty miles distant from land. The weather conditions on this route are as good as on the U. S. transcontinental air mail line.

In the winter a plane equipped with skis would have a landing field underneath it for half the distance. In the summer sea planes would have to be used, or landing fields built at strategic spots. To anyone who has not recently studied a map, it sounds incredible that the shortest way to Japan is to fly northwest. It is only because the airplane makes it possible to travel in a bee-line that such a route would be possible. But a moment's study of the map will show that the northern route is a short cut which will cut days from the time of regular railway and steamship schedules. The development of this route through the north is going to be the next great forward step in aviation.



Before airplane engines can be started in the icy temperatures of the Polar regions, they must be thoroughly warmed-up. Asbestos coverings are draped around the engines leading to the stoves. They start easily after a half-hour's heating.

MAJOR ARNOLD

A pioneer in the field of aviation, Major Arnold is a nationally known expert on modern aircraft. During the war, he was Assistant Chief of the American Air Service, with the rank of Colonel. Later he became Chief of the 9th Corps Area. His expert comment on aviation developments is a regular monthly feature of Modern Mechanics Magazine.

Modern Types of Airplane Landing Gear

AIRPLANE landing gear must be strong enough to withstand the violent bumps and jars resulting from landings made in rough ground and at the same time be light and afford a minimum resistance to high grass, mud or other ground objects. The wheels must be large enough to roll unimpeded over small ditches and inequalities in the ground. The tires if too small, will sink into soft ground. Lightly constructed wheels will crumple when the plane lands into a slightly cross wind. The entire assembly must be easily maintained and free from parts which get out of order or which can be put out of commission by dirt or dust.

The landing gear is required to carry a heavy load. When the plane strikes the ground the weight is suddenly thrown upon the wheels through the landing gear struts. Accordingly there has to be a certain amount of elasticity in the system or the landing gear will crumple. Normal landings are made with the wheels gradually dropping to the ground, the weight being taken up without any shock at all. However, with inexpert pilots or in landings made at night or in thick weather, the plane may be dropped to the ground from heights of ten feet. The weight to be absorbed varies from 5,000 to 15,000 pounds. Accordingly the shock absorbing system must be of sturdy construction.

Early Landing Gears Were Rigid

The types of landing gears used and in use are many. Glenn Curtiss in the plane with which he won the first Gordon Bennet race at Rheims, France, in 1908, had a three wheel landing gear without any shock absorbing system. The wheels were mounted rigidly to the struts. Later he used a rubber

In order to reduce wind resistance, this amphibian plane has been equipped with recesses in the hull into which the landing wheels and struts can be drawn when not in use.

Hydraulic shock absorbers are being installed on the latest types of airplane. A plane equipped like the one above can survive a shock which would crumple up an ordinary landing carriage.

shock absorber device. Bleriot in one of his early planes used steel springs. The first Wright planes had no wheels and all landings were made upon skids rigidly attached to the airplane. All planes, however, soon adopted some kind of rubber shock absorbing devices.

As the years went by the planes landed at higher speeds and were greatly increased in weight. This added ever increasing strains to the landing gear. The general type in use was the all-through axle which supported the weight of the airplane by means of rubber strands. These strands were made up into cords by covering a hundred or more strands by a woven fabric tube. Several strands of this cord held the axle in its place at each end. In case the cord broke, the upward motion of the axle was limited by guards which prevented the supporting struts from scraping the ground.

This type was satisfactory for a while but the life of the rubber was short as it was under a constant tension. It had an additional objection in that the spreader bar connecting the two parts of the landing gear and stream lining the axle was only a short distance above the ground. Thus there was a considerable resistance always given to high grass or weeds when the plane was taking off. The spreader bar acted almost as a brake.

The objections to the low spreader bar were slightly removed when the designers increased the size of the tires. This raised the bar and made the planes more serviceable in muddy fields, but it was only a partial solution. A landing gear was required that would offer a minimum resistance to the vegetation and mud on the average field which would be used by airplanes.

Bleriot in 1909 had a landing gear in which each wheel was attached separately to the fuselage. Thus there was no resistance offered to high grass or weeds other than that of the wheels rolling through. The only objection to this type was the securing of sufficient strength when it was attached to the plane. The increased size of planes made the solution of this problem quite simple as it was possible to use a triangular system of struts. The general use of metal construction in airplanes gave added strength to the landing gear.

Hydraulic Shock Absorbing System

The modern landing gear has rubber rings so arranged that the shock resulting from the plane dropping to the ground is carried upward from the wheels by compression of the rings. Thus there is no strain on

This is a popular type of landing gear for light airplanes in which there is no spreader bar or axle between the wheels, and consequently no resistance is offered to long grass on the flying field.

the rubber while the plane is in flight and the landing shock is taken up by compression rather than by tension. Accordingly the life of the rubber is much longer.

There is also a general tendency now to supplement the rubber rings with a hydraulic system. A system of plungers and cylinders is installed by which oil is forced through a small orifice when the landing shocks occur, but the oil returns to its normal place through larger holes. This makes it possible for the pressure to be gradually extended through the landing gear to the fuselage but provides for the quick return of the oil to its reservoir where it is available for any future shocks.

Thus the landing gear on airplanes today is practically fool proof. It is seldom if ever that the combination rubber ring-hydraulic landing gear is damaged in rough contacts with the earth. There have been instances where pilots have dropped their planes ten or more feet to the ground without damage. The system permits of a maximum motion of about a foot between the flying position of the wheels and their position at the initial shock of landing. The system is so effective that the occupants of the plane can barely feel the shock even in a very bad landing.

Both the rubber rings and the hydraulic system are located in the landing gear struts. They are stream lined and thus present no additional head resistance while the plane is in flight. The difference in weight between the old type of shock absorber cord and the combination rubber ring-hydraulic device is practically negligible. However, as in all mechanical devices which are exposed to large variations in temperature, a much lighter oil must be used in winter than in summer. The oil reservoir can be readily drained and filled through draining plugs and filler caps. The stream lining can be removed by loosening a couple of wing nuts for inspection purposes.

Novel Airplane Flaps Wings Like Bird

AN UNUSUAL type of airplane with wings which flap like those of a bird has been constructed by James A. Crane of Ellsworth, Maine. It is designed to rise straight into the air, but it is not a helicopter machine as are most airplanes intended to ascend vertically. The wings are flapped by a crank and the beating motion is expected to propel the craft just as a bird's wings waft it through the air. The inventor calls his machine the Eagle Plane.

Another unusual feature of the airplane is that the motor is fastened to a swivel base which can be turned by the steering gear. The large tail area of the ship is another departure from conventional design. When the wings are covered with fabric, the craft will be ready for its trial flight.

Note how closely the inventor of this unusual airplane has patterned his ship after the lines of a bird. He calls it the Eagle Plane. —Times Wide World.

How to Keep YOUR BATTERY FROM FREEZING *this Winter*

Do you know the best way to start your car in cold weather so that the drain on the battery will not be excessive? The pointers on winter driving given in this article will save time and money for the motorist.

THE plates in a storage battery are made up by pasting what is called active material into the plate grid, which is pure lead with a little antimony added for alloying for strength.

The active material is in paste form when applied to the grid and it is allowed to dry before the plate is formed and put into use in the battery. When the battery is charged an electro-chemical action takes place. When it is discharged a chemical-electro action results in current production and this lights the lamps, turns the starter, furnishes current for ignition and so on.

This paste or active material never becomes extremely hard. It is more or less porous. It must be so to do the work. The liquid solution in the storage battery is diluted sulphuric acid. Pure sulphuric acid weighs almost twice as much as water, 1.835 to be exact. The acid or electrolyte in the battery weighs 1.285 (approximately) as most drivers know from testing their batteries with the hydrometer, which is merely a device for measuring the comparative weights of fluids.

The photo above shows two battery cells which have been discharged to such a degree that they have frozen. The third cell was in better condition and therefore resisted freezing.

When a battery is discharged the sulphur from the electrolyte enters the porous active material of the plates and remains there until driven out by the charging current from the generator. When the battery is discharged the sulphur leaving the electrolyte leaves the solution in a more nearly pure water state. That is, there is less acid and more water in the solution and the hydrometer will show its weight as little more than that of water, which is 1.000.

Accordingly, when the hydrometer reading of the battery shows about 1.100 to 1.150 the battery is said to be completely discharged and the battery will freeze.

A battery with two cells frozen is shown in the photo. The one at the right end of the battery was in better condition. The two which were frozen were more completely discharged. Note the ice in the cell cover opening.

Results of Freezing

It would seem that a little freezing, as long as the cells were not fractured, would do no harm. Such is not the case. If the reader will refer to the second photo he will see exactly what may happen when a battery freezes. If the active material had not been forced out it still would have been worthless. Freezing destroys the structure of the active material and leaves it useless.

All that is necessary to keep the battery from freezing is to keep it sufficiently charged for the climate in which it is used.

TEST THE BATTERY REGULARLY WITH A HYDROMETER

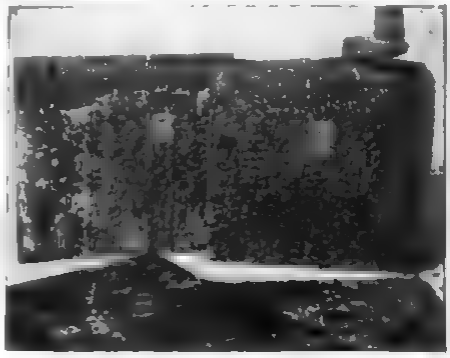
The following table will give the figures:
Specific Gravity Freezing Point.

1.100 ....19 degrees F. above zero
1.150 .... 5 degress F. above zero
1.175 .... 6 degrees F. below zero
1.200 ....17 degrees F. below zero
1.220 ....31 degrees F. below zero

It is easily seen that a hydrometer reading of 1.200 is pretty safe for most sections of the country, except those in the far north. But this is still bad for the battery, since its efficiency is low at any point below 1.250 in the cold months and it is desirable to keep it even more fully charged than that.

In cold weather the car will start hard. As the saying is, "the battery is simply up against it." The owner of the car will give the battery its best chance if he will see that everything is right for easy starting. Some pointers are: Use good gasoline. Keep spark plugs right. Keep battery fully charged. Press out clutch when starting. Use a thin grade of motor oil (consult reputable oil charts). Have all connections clean and tight (battery and ignition wires and cables). Keep car in warm garage if possible, when not using it.

If in spite of all precautions the battery is discharged in an attempt to start a cold engine, it should be removed from the car and recharged.



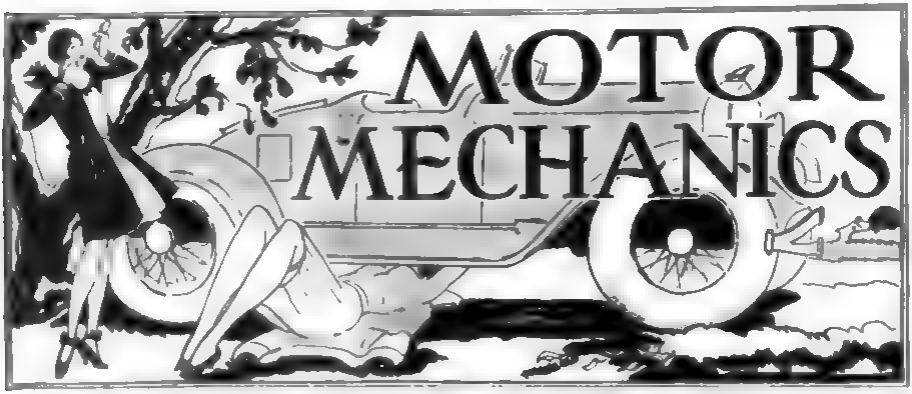
A group of plates illustrating how freezing ruins a battery is shown at A; B, B, and B are separators pulled from A. Note how the particles of active material have been forced out of the plates and now adhere to the separators.

A COLD TIRE PATCH THAT STICKS!

MOTORISTS who like to put on a cold tire patch that is nearly as good as a vulcanized job and which will seldom if ever come off can easily do it without additional work or trouble. The whole secret lies in the way the patch is cut.

Usually in cutting a patch for a cold job the rubber is trimmed with edges at right angles to the surface of the patch. This leaves the edge of the patch just as thick as the rest of it. In order to put one on that will stick all that is necessary is to turn the blades of the scissors at an angle to the surface of the patch and bevel the edges. This leaves a feather edge completely around the patch which will stick permanently to the tube. Perfect adhesion can be obtained in this way. A patch cut in this way will give as good service as a vulcanized job and will practically never come off. Such a patch does not tend to wear out the tire as do patches with thick edges which cut into the tire.

If the scissors are held at an angle when cutting a tire patch, the edges will be beveled as shown.



Conducted by **RAY F. KUNS**

As director of the Automotive Trade School of Cincinnati, Ohio, Mr. Kuns is a nationally known authority on automobile mechanics. By following his expert comment in this magazine each month, the automobile owner will be able to keep his car in the best of condition by avoiding careless driving practices which take hundreds of miles from the expected service of the car.

Worn Oil Pump Means Faulty Lubrication

OIL PUMP gears which are pumping the vital oil fluid to the moving parts of the engine are continually working in a bath of the very oil they pump. Yet they wear.

This oil pump was shirking on the job. The gear teeth were worn so badly that the engine was damaged because vital bearings were not receiving enough oil.

What causes it? Possibly the carbon grit and dirt which finds its way in a powdered form into the oil.

At any rate, in the photograph we have the evidence of wear. Note the gear teeth worn half away. Naturally it is a serious thing when gears become so worn that the pump allows the oil to "slip backward," even if only a part of it is evading its duty.

Most any one who likes to take care of his own car can get at the oil pump and after cleaning the dirt from its outer surfaces remove the cover and inspect the gears. This should be done if the car has been run a matter of twenty thousand or more miles, and especially if the oil pressure is low or unsteady.

If the gears do show appreciable wear, replace them. For those who do not care to do the work themselves this is a tip to have the garageman make the inspection and install the new gears if needed. The oil pump is like the heart. When it "misses a beat" or "starts to flutter," look out!

Racing Cold Motor is Best Way to Wreck it

TEN thousand times we do it and then the ten thousandth and first we regret it. The driver of the engine which formerly incorporated the parts shown herewith raced the engine once too often. After this rod

Here is something which was once an engine connecting rod. The section from the cam-shaft was knocked off by the rod when it let go as a result of the driver's racing a cold engine.

let go and knocked the four-inch section from the cam shaft and split the crank case wide open and lifted the cylinder head off the block in pieces, the best that could be said for the car was, "she was a good ol bus in her day." The most charitable thing which could be said for the driver was that he should have known better.

Racing a motor "wide open" without any load, as when the car is standing and the engine is being warmed up, is likely to be attended with serious consequences. It may not always result in broken parts. It *will always* result in strained parts and in undue wear. It will take miles from the expected service of the car. It will make the motor noisy. And then one is all too likely to have a new acquaintance in prospect, the junk man, the fellow who eventually gets all the automobiles.

"My Starting Motor Wont Turn Over the Engine"

THIS is a very usual complaint, especially on the part of new drivers. By far the greatest number of cars are now equipped with the Bendix drive. This is a device used for automatically connecting the starting motor with the fly-wheel ring gear when the driver steps on the starting switch.

In the upper corner is shown a new Bendix drive. The result of stepping on the starter when the engine is going is shown below it.

The fact which is not realized by the new driver is that the device is intended to operate only from a standing start. Frequently in cranking a motor, it will fire a time or two and then quit. When the driver notices that the engine is stopping he will step on the starting motor switch in order to prevent it. This will result in a wrecked Bendix drive and damaged ring gear teeth. Some day when he steps on it there will be just a little buzz. As a rule this means the Bendix spring is broken and the Bendix will need to be pulled in order to effect a repair.

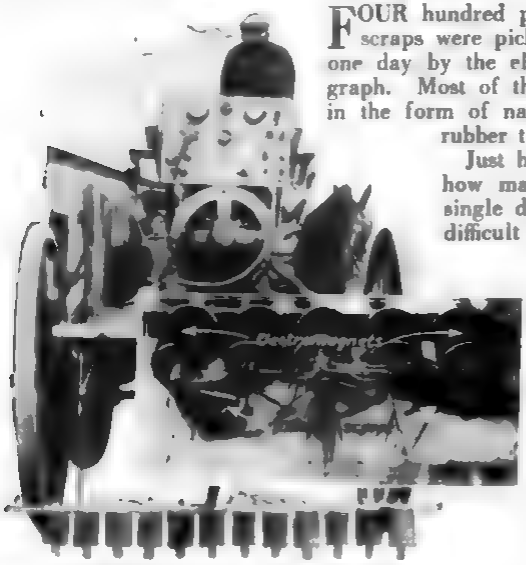
The one rule in the use of the Bendix is never to step on the starter switch when the engine is running, or the fly wheel rocking back and forth. Sometimes the damage is far more serious than a mere broken spring, as is evident in the accompanying photograph. In this case the starting motor shaft was badly sprung and other parts wrecked.

BALLOON TIRE BALANCE

Many balloon tires are marked with the heavy or the light point on the tire tread. If the mark is at the heavy point then the tube stem is placed at the point exactly opposite the mark, which is usually a red point. If the mark is at the light side of the casing then the tube stem is placed even with it. Ask the dealer how his tires are marked. This method is used to assure better tire balance and will help to prevent tire tramp or shimmy.

Do not place "boots" in the front casings if balloon tires are used. If this must be done in an emergency, place two boots of equal weight, one to do the work and the other to balance it and prevent vibration and front wheel wabble or shimmy.

Electric Nail Picker Protects Auto Tires



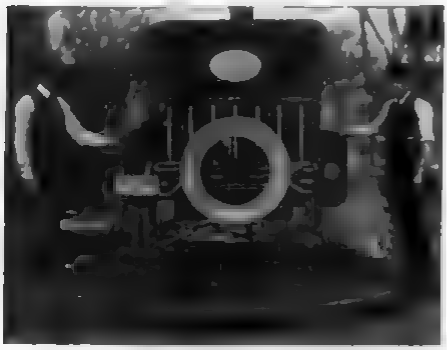
FOUR hundred pounds of nails, tacks, and other iron scraps were picked up on a South Dakota highway in one day by the electric nail-picker shown in the photograph. Most of the metal gathered by the machine was in the form of nails and sharp fragments dangerous to rubber tires.

Just how many punctures were prevented or how many dollars saved for motorists by a single day's work of the machine it would be difficult to estimate, but inasmuch as all the sharp scraps were picked up from the middle of a well-traveled highway, the machine is considered by highway authorities to have demonstrated its value.

Powerful electromagnets attract the metallic scraps. The magnets are drawn along behind a wagon and are placed close to the surface of the road. The nail-picking unit is self-contained and can be mounted on a wagon or truck as may be desired.

PAINTED AUTO PROTECTS CROSSING

ALL methods of protecting a dangerous split crossing in Columbus, Ohio, failed until someone suggested that a sign showing the back of an automobile be erected. The picture shows the completed warning sign. From a distance the painted automobile looks deceptively like a real machine, with the result that motorists approach it cautiously. As a safety measure the sign has won the enthusiastic support of the Columbus Automobile Club, which is erecting similar ones at other danger spots. A red tail light is wired up to make the sign effective at night.



WHITE TACKS DIRECT TRAFFIC

Traffic lanes in London are no longer marked by the usual arrows painted on the pavement. The paint wore off too quickly under heavy traffic, so authorities had to devise a more permanent marking. Now they use tacks with white porcelain heads.

NEW USES *for* OLD FORDS

This old Ford has been adapted for service by a U. S. Forest ranger. Flanged steel wheels enable it to run on mountain railway tracks.

TEN dollars will be paid for each photograph accompanied by a short article suitable for use on this page, showing how an old Ford has been adapted to a novel use. Send in your ideas and photos!

MANY an old Ford whose tin body has shaken itself to pieces after long years of service still has a motor almost as good as new. What becomes of all the old Lizzies? Thousands of them go to the junk pile every year, but other thousands are adapted by ingenious mechanics to all sorts of uses. The old Ford in the picture above is well along in its teens, but it is doing good work in patrolling a dangerous forest-fire area in Montana.

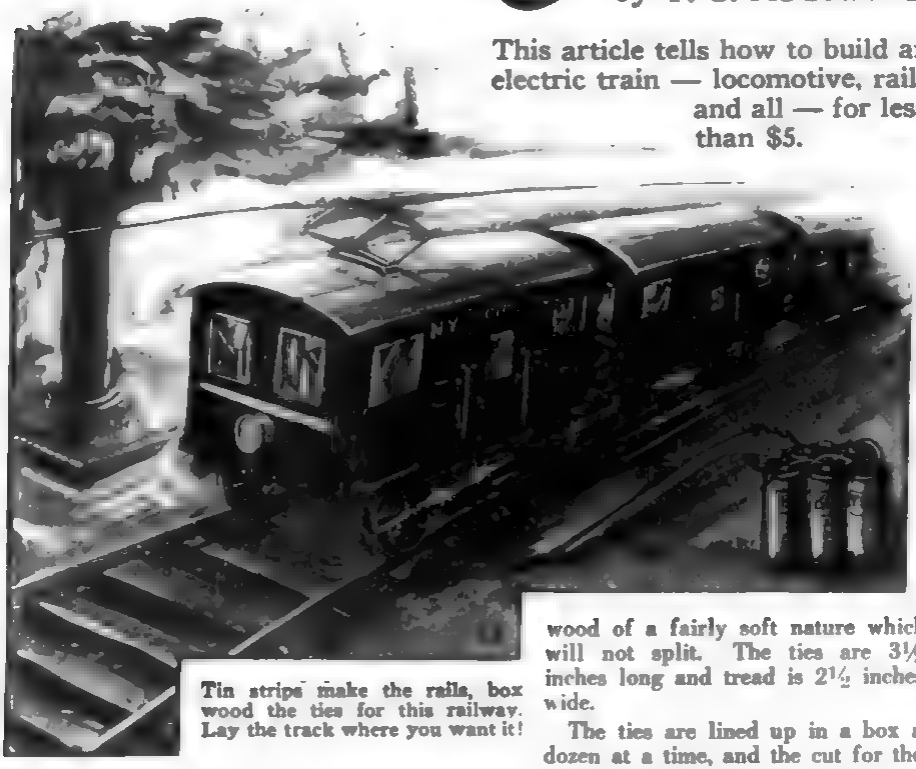
As another example of the usefulness of an old Ford, glance at the picture showing a car pulling a slip scraper. A horse being unavailable, this home owner of Benson, Nebraska, attached a chain to the axle of his car, fastened the other end to the scraper, and with the assistance of a helper at the wheel soon had his lawn graded.

What unusual uses do *you* know for old Fords? Take a photograph of the ancient Lizzie busy at some unusual job, write a few words of explanation, and send it to Modern Mechanics Magazine, Robbinsdale, Minn. If accepted for use on this page you will be paid $10.

Build this ELECTRIC

by T. S. ASGAARD

This article tells how to build an electric train — locomotive, rails and all — for less than $5.



Tin strips make the rails, box wood the ties for this railway. Lay the track where you want it!

THIS electric railroad train is built of tinners cold rolled sheet metal and wood. The cost of a fifty-foot railway will not be more than three or four dollars, and the complete system is much more realistic than the store kind of toy.

The track is made first. Half-inch strips of a fairly heavy galvanized roofing sheet are cut off by the local tinner. He has a machine which will deliver the strips in this width and about thirty-six inches long. Every two strips will add three feet to the length of the system, so it is best to lay the road with clothes line first, so you can tell where it will go. Then measuring the clothes line will give you the length of the strips to put into the track.

The ties for the track are made of $\frac{3}{8}$-inch wood of a fairly soft nature which will not split. The ties are $3\frac{1}{2}$ inches long and tread is $2\frac{1}{2}$ inches wide.

The ties are lined up in a box a dozen at a time, and the cut for the strip of metal made with a fine backsaw.

Plan Your Own Track

You will need about seven ties per foot of road. The advantages of this kind of track are that *any kind of curve can be had.* There is no sharpness to the curves, and they can be laid into the track when you are setting the train up.

The joints in the track are made this way. A piece of soft wire is mashed down where the lap in the rails occurs so the circuit will not be broken. Each rail is insulated from the other by the wood ties, and each forms a line of the circuit. There is no third rail. This makes the line look more realistic. Because the resistance of the rails is high, every four or five feet should have a contact by copper wire direct from the battery.

TRAIN for CHRISTMAS

The batteries on which this railway operates can be home made. To make this, get the black carbon centers from old dry batteries. You will need six of them, or six fair-sized pieces of hard coke will do. Get six pieces of flat, thick zinc about an inch wide and six inches long. Also six Mason jars. The zinc and the carbon are bound to each other with string after a piece of adhesive tape has been wound around the zinc where it would otherwise have touched the carbon.

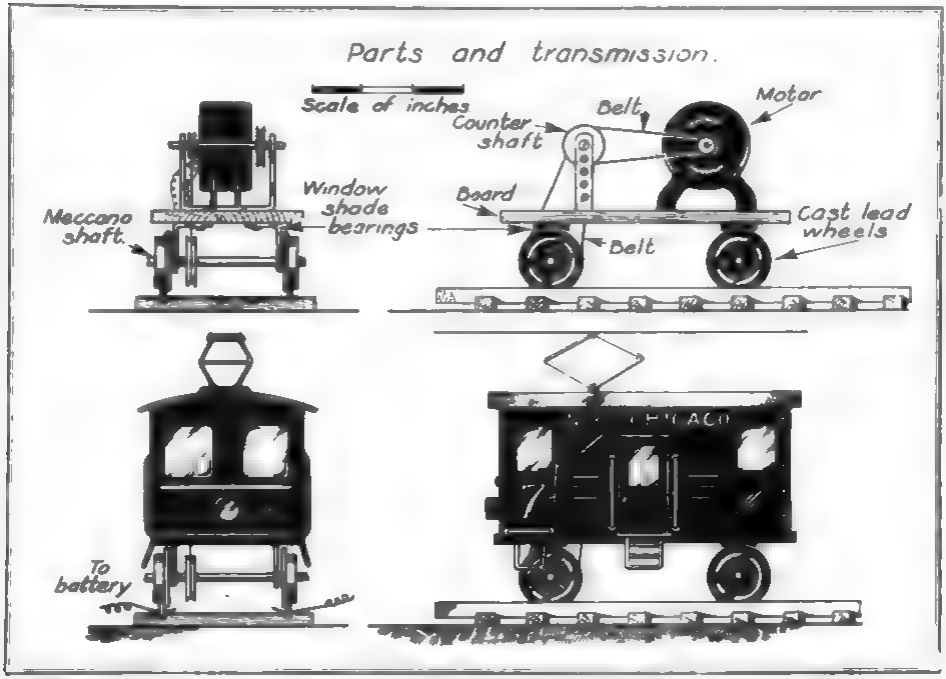
The jars are filled two-thirds with a solution of sal-ammoniac. Sal-ammoniac can be bought at any drug store, and a saturated solution means that all of the powder which can be is dissolved in the water.

Then the zinc-carbon elements are lowered into the solution and connected in series, just as you would connect ordinary dry cells. Wire is attached from the track to one zinc, thence they run from carbon to zinc and finally from carbon back to the rail. This battery set will give nine volts and will cost fifteen cents for the chemicals, which, while harmless, should not be slopped around any. A sal-ammoniac solution is the name of an ammonium chloride solution. It is not an acid.

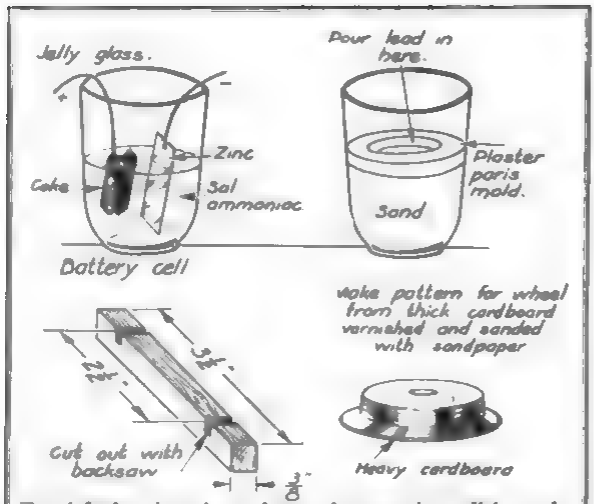
Care of Battery

In using this battery, be sure that when the train is not running that the elements are out of the solution because the battery makes the same amount of electricity idle as when in use. A shaking will run off the hydrogen bubbles which form, causing the battery to slow down.

The engine comes next. It is simple and is built on an ordinary Ajax two-dollar motor, meccano axles, tin body, and cast lead



The two top drawings show the elements of the engine. The bottom drawing shows how a tin or cardboard body should look. Windows can be painted or made of celluloid.



Top left drawing shows how sal-ammoniac cell is made. Top right drawing shows mold for casting lead wheels. Right bottom shows wheel pattern. Dimensions of ties are given at lower left.

wheels, which you can make or buy. The journals are the simple end of Hartshorn window shade fixtures screwed to the wood car platform so as to hold the axles.

First the platform is made. This is a piece of hardwood such as oak, planed to a quarter of an inch thickness, drilled and laid out as shown. The counter shafts are mounted and the body temporarily fitted, as well as the motor, to see that all dimensions are good and accurate.

Then the wheels are made in this way. A wheel is turned out of, or whittled out of wood, which is one and a quarter inches in diameter. The flange wheel must be cut into it and it must be perfectly round. One good way to make the pattern is to glue a piece of wood to the wheel of the bench grinder and cut out the wheel while some one helps to turn the grinder.

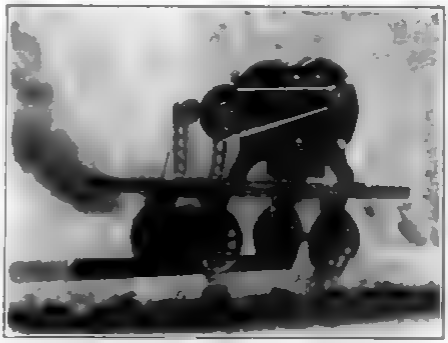
Then after the pattern has been shellacked, it is placed into plaster of paris according to the drawings. Four or five molds should be made, in separate glasses, before the pouring of the molds with melted lead, which can be heated to melt over the gas stove in a heavy scullery spoon. It is best to make the bottom of the molds of dry sand. If the whole mold is plaster paris, there will be so much moisture that the casting will have steam bubbles formed in it.

Place sand in first, then pour the plaster, and when it has almost set, place the pattern in. The mold will then be easy to pour.

The wheels must be drilled so that they will drive into the axle snugly. A fifth wheel is put on one axle as shown after the flange has been filed or whittled off with a knife, and a groove put in for the rubber bent.

The shade fixtures can be installed last thing and the engine is ready for a preliminary tryout. Black makes the best color to paint it, and the Duco kind of enamel which dries quickly is the best. Gilt coloring can be used and the representation is not half bad. There can of course be other types of engines made, but the electric locomotive is chosen because it requires no tender, and looks well running alone.

A light inside the engine makes the engine look like a real loco. A four cent porcelain socket and a flashlight bulb will not take too much current, and the effect of realism well repays the effort required to install it. If the train is run in a dark room, the light is particularly realistic.



This shows how the engine looks before the body is mounted and gives an idea of how the track appears when ballasted.

A Home-Made Train for Less than Four Dollars!

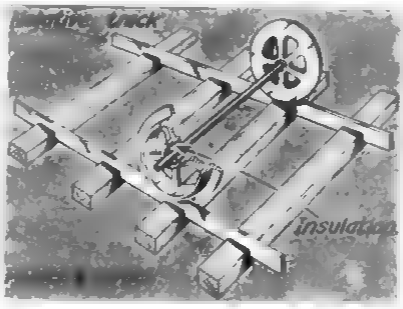
The ties of the line can be creosoted to look like real ties, and though they smell the house up, realism is gained. Bridges and tunnels may be made of cardboard boxes, reinforced with plaster of paris, which can be made to dry faster by putting a bit of salt in it.

Cars can be made and hauled, for this engine develops surprising tractive power. A few suggestions are given in the drawings accompanying this article.

The lead wheels are apt to bruise easily, and the engine should be handled with care. It is a good plan not to oil the motor commutator, as it will gum up and be hard on the batteries.

The train can be made to reverse by using a switch which reverses the positive and negative sides of the rails. This reverses the polarity of the current and reverses the direction the motor runs in.

Many things can be home made which will add to the fun of running the train. Depots can be built, with lights in them. A telegraph system can be made. Thus, for a few dollars and a few evenings' time, you can have a railroad which will give you more fun to the dollar than any you could buy elsewhere.

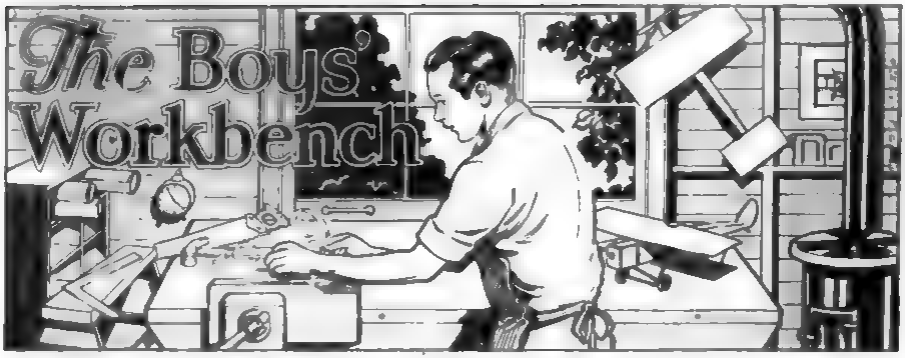


The shaft hole of alternate wheels must be reamed larger and insulated with fiber set to a tight fit to insulate the two rails from each other. The current is transmitted from the wheel to the axle, then to the window shade bearing, where a wire leads it to the motor.

Probably you will want to use the train outdoors in the summer time. Many people who own toy trains use them in this fashion and particularly are garden trains quite the thing in England, where in some cases the railways represent quite elaborate outlays both in rolling stock and in equipment. Some of them are fifteen miles long! Should you so desire, board bedding can be used, the ties nailed to them and the road laid out accordingly. In such a case the ballast had best be pure plaster of paris. As the plaster dries, it should be covered with a good grade of poultry gravel, for unless this is done, the rain will wash the plaster away. Plaster of paris road ballast can't be used out doors.

In an outdoor railway all the curves and grades should be gentle, and if possible, placed where no leaves or debris will fall on the tracks. Another thing which will need attention in a railroad used outdoors is the need for feeder wires running to all points of the line. These should be copper and as the rails have a high resistance the current will fade from point to point about the track unless the precaution is taken. Also stronger batteries might be used.

AFTER you have made the electric train described in this article why not try your hand at building a model boat? Modern Mechanics is awarding a handsome engraved trophy cup and cash prizes for the best models submitted in its Boat Building Contest. Rules and other details, including plans for a model boat, are printed elsewhere in this issue. Build your model and join in on the fun!



Conducted by A. NEELY HALL
Author of "The Handy Boy," "Outdoor Boy Craftsman," etc.

This month the department editor gives directions for building an attractive toy village to be placed at the base of the Christmas tree to surprise the young folks on Christmas morning. Begin building your village now, following the directions given by Mr. Hall in this article, and you will have everything finished in ample time for Christmas.

A Toy Village for the Christmas Tree Base

THERE will be a Christmas tree in your home, of course. It would not seem like Christmas without one. Mother and father may say that the tree is for you but, if you really knew, it means as much to them as to you. Dressing the tree is probably mother's job. But the tree must be set up in readiness for her, and this may be your job. There is no reason why it should not be.

First, the tree standard. Perhaps father has invested in one of those quickly adjusted holders now on the market, or devised a home-made rig of his own. But standards have a trick of disappearing during the year, and sometimes it becomes necessary to knock together a base in a hurry.

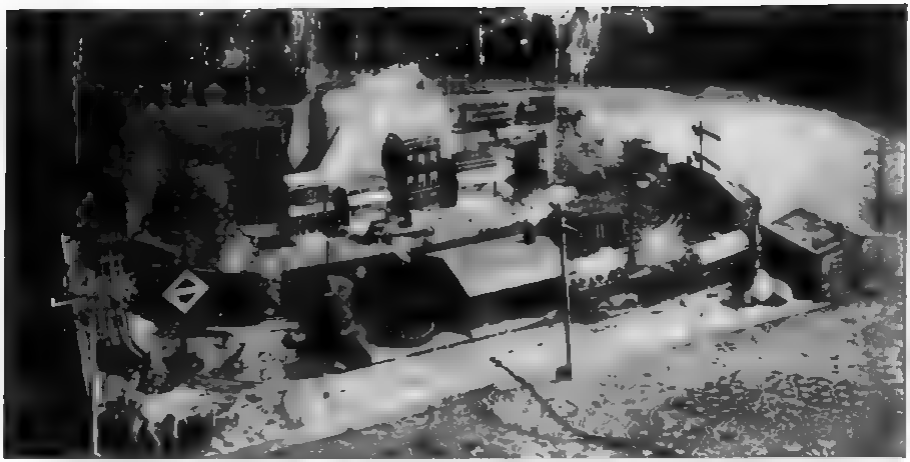
Making the Standard

The grocery-box base shown in the diagrams is easy to make. A box, 10 inches deep, 14 inches wide and 18 inches long is a good size, but a larger box will do. Besides the box and cover, hunt up two box boards. The boards are to form a pocket in the lower part of the box, like that shown in Section 2 of Fig. 1. Cut the boards of the right length to fit between the box sides, then saw a V-shaped notch in the center of one edge of each. The size of the notch will depend upon the diameter of the tree, but a pocket 2 inches across will accommodate a tree of medium size, and the boards may be set apart for a larger tree, or the trunk may be shaped with an axe to fit. Fasten the notched boards with nails an inch or so above the box bottom. Make a similar pocket in the box top, and fit the boards so the notches will come over those of the lower pocket. One top board may be nailed. The other should be screwed on so that it may be removed easily. If the tree is large, place several bricks or stones inside the box, to prevent upsetting.

You can paint, enamel or lacquer the box standard, or conceal it with cloth or crepe paper.

The Toy Village Model

You can use the tree base as a center for



Directions for making this handsome toy village are given in this article.

an interesting model like that shown in the photograph. Such a model will make the greatest hit imaginable, especially with your younger brother or sister. Keep the idea under your hat. Or, you might let father in on it, since the picture shows the use of toy railroad equipment, and if you have none, or very little, it may occur to him to buy an outfit, or accessories. But don't forego the model for lack of a railroad. Build an island village instead. with a harbor and airport.

The model illustrated was laid out upon a board platform, but wallboard will serve as well, or a bed sheet will do for a foundation. You need not follow the layout of the picture. But the general arrangement of treating the tree standard as a mountain, and setting up buildings around it, with stores and the main business street upon one side, then encircling the village with tracks, is a good one.

Make lists of the accessories that you will need, one list of the things you have, another of things you can make, and a third of things you must buy. Purchases may be confined to such items as you pick up in a ten-cent store. You will need boxes in which to pack articles as collected, and a closet or storeroom in which to hide them from prying eyes.

The church, theater, hotel and store building of the model in the picture were made of small cardboard boxes such as small hardware comes in. You can get these empty boxes at any hardware store. Doors and windows were painted with water colors. A

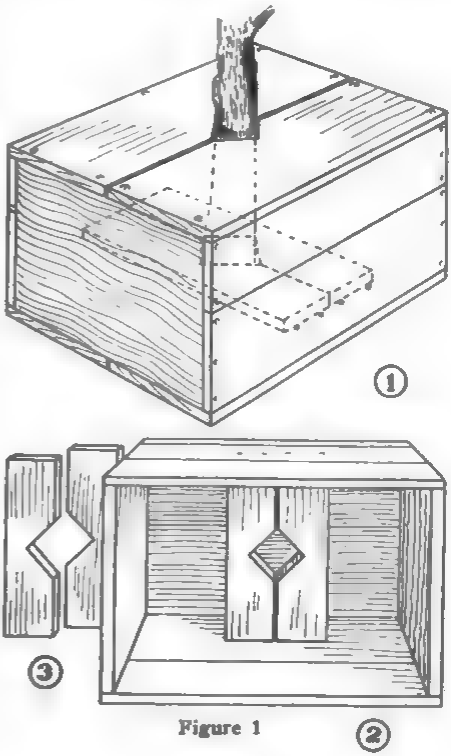


Figure 1

long slim box with a steeple made of paper was glued to the side of a square box with slanted roof, for a church. Paper awnings were glued to the store fronts. These accessories can be made quickly.

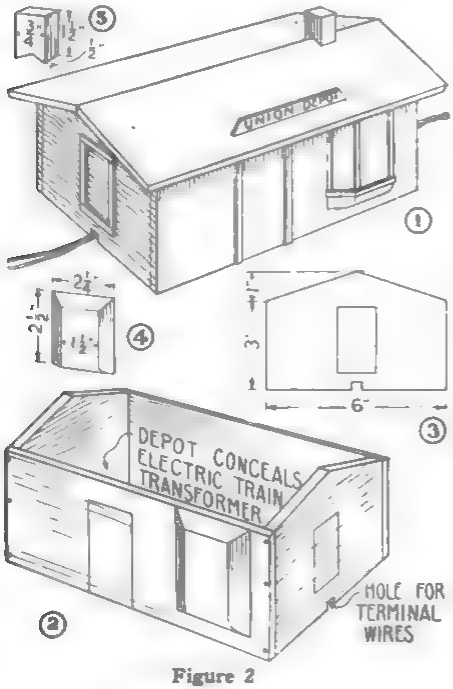


Figure 2

A Railroad Depot

Build the railroad depot for a younger brother's Christmas gift, and it will serve a double purpose.

Section 1, Fig. 2 shows a depot that is easy to build. It is made without a bottom so that it may be set down over the electric transformer. Section 2 shows the assembled walls without the roof. The building measures 4 inches high, 6 inches wide and 10 inches long. Maybe you can find a wooden box of this size. If not, use box boards. First, prepare two ends by the pattern of Section 3, and cut a small notch in the bottom of each to admit the electrical terminal wires. To these pieces nail two 10-inch boards for side walls.

Door and window openings may be sawed, but it will save time and serve the purpose to draw openings, then tack narrow strips around the outlines for casings. The ticket agent's bay window is made of a small block of wood shaped like the detail of Section 4, and glued and nailed to the front wall. Slant the sides of the block, round the bottom, and tack and glue strips of wood to it to outline the window openings.

Cut the roof boards large enough to form a projection of 1 inch over the walls. Glue and nail the boards to the walls. Make a chimney of a block of the dimensions given in Section 5, and mount it near one end of the roof.

Once upon a time, village depots were painted red. Now you will see them in yellow, green and other colors. Mother may have a partly used can of lacquer or enamel that will be right for your depot model.

In the photograph you will see a water tower to the left of the depot. All it requires is a tin can with a peaked roof, shaped out of tin, a spout of two pieces of a dowel-stick glued together at right angles, and a wooden base on square stick supports braced with diagonal sticks.

Building a Tunnel

You can easily make the railroad tunnel that you have long wanted for your outfit. At the extreme left of the photograph, and in Fig. 3 of the diagrams, you will see my home-made model. It looks as good as any store model, does it not?

First of all, you need a wooden foundation like that shown in Section 2. This requires two side pieces and two top pieces of the shape and dimensions given in Section 3. Plane off the edges of the boards to make them fit when slanted as shown. Glue and nail them together, then tie the bottom edges with strips of tin nailed across them as shown.

Modeling the mountain rocks is fun. You need several cheap sponges to tear up for trees, newspapers and plaster-of-Paris for modeling materials, and large tacks.

Drive the tacks into the fountain, an inch or so apart, with heads left projecting as a binder for the modeling material. Then tack the sponge trees in position, grouped about as shown.

Mix the plaster-of-Paris with enough water to make a thick paste, then tear up a newspaper into bits and stir these through the plaster until they are well coated.

Plaster-of-Paris sets quickly, and it may harden faster than you can use it. You can retard its setting with a few drops of vinegar, or by adding borax in the proportion of 1 part of a saturated solution of borax to every 12 parts of the water used in mixing the plaster.

Cover all surfaces of the tunnel foundation with the plaster coated paper, and mold the paper into rock formations. Then allow the model to stand until the surfaces have become hard.

Painting is next. Paint the rocks dark gray or brown, the trees green, and add a daub of green here and there among the rocks to indicate vegetation. Paint the inside of the tunnel black or brown.

After the Christmas tree has been dressed, and the family has withdrawn to permit you to complete the job about which there has been so much secrecy, get out your boxes of accessories and see how quickly you can complete your prearranged layout. Drape the tree standard with white cloth, and sprinkle powdered mica "snow" over the cloth. Build roads with sand, use a broken mirror for a pond or lake, concealing its edge with sand and stones. Build a bridge over the pond or lake. Set up trees made of sponges or sprigs lopped off the Christmas tree. And do not forget to lay out a telegraph line. Poles should have been made beforehand of dowel-sticks, with cross arms, and wooden bases. Use wire or string for lines.

Give your imagination free rein, and you will think of many other features to work out in this village model.

One thing which will add a great deal of realism to the model village is the installation of a complete lighting system which can be controlled from a central switch. Street lights can be very easily made by using flash light bulbs, wire from some such source as pail handles for the upright arc of the pole, and ordinary wood base anchored to the floor with a pedestal of Plaster Paris to anchor it and keep it from upsetting.

These small lights can be placed in the depot, in the drugstore and in the tunnel. The lights should be wired in series; that is, each light should have an independent switch and lead to an independent supply of current. It can then be made to flash on and off independently and this touch will be found extremely effective in making the labor of building the village worth while.

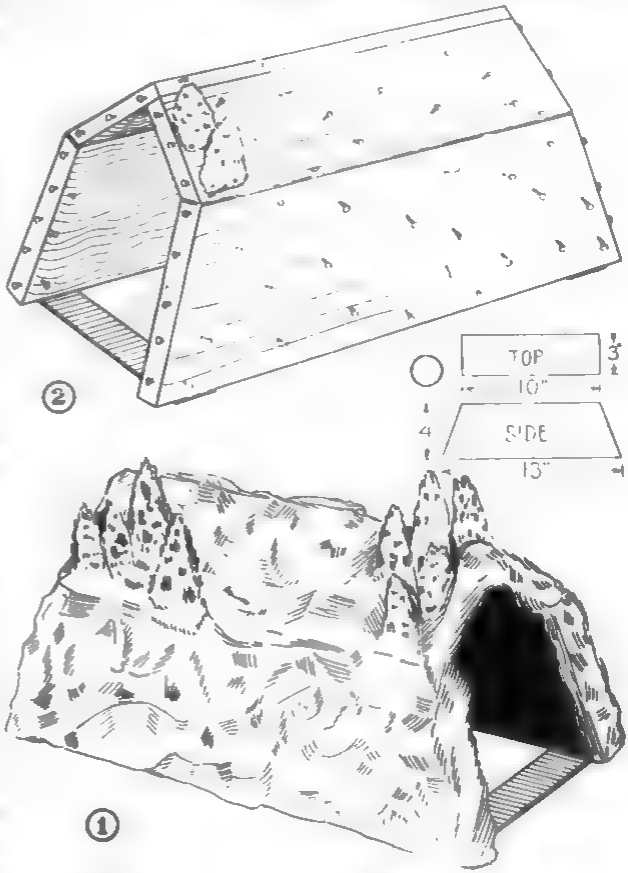


Figure 3

CONQUEST of the

Startling story by EDGAR RICE BURROUGHS

Famous Author of "TARZAN"

Carried to the heart of the Moon in a marvelous interplanetary cruiser, the daring Earth men are captured by a tribe of fierce horse-humans and forced to battle for their lives in a weird world. Begin this serial of strange adventure in this issue—a summary of what has gone before is printed as part of the story.

PART II.

ON DECEMBER 24, 2025, the interplanetary ship, *Barsoom*, left the surface of the earth, speeding towards Mars. There were five of us within its steel shell—five adventurers piercing the dismal wastes of space where man had never before penetrated. We were Lieutenants West and Jay, Ensign Norton, Lieutenant Commander Orthis, and myself, Julian, teller of this story and commander-in-charge of the expedition.

Orthis was a brilliant but treacherous man who had hated me bitterly since our cadet days. It was Orthis who isolated the Eighth Ray, the propulsive waves of energy which enabled *The Barsoom* to travel through space, and he was sullenly resentful because the government had placed me in command of the ship instead of him. Not until we came within a short distance of the Moon, however, did his hatred for me take a destructive form.

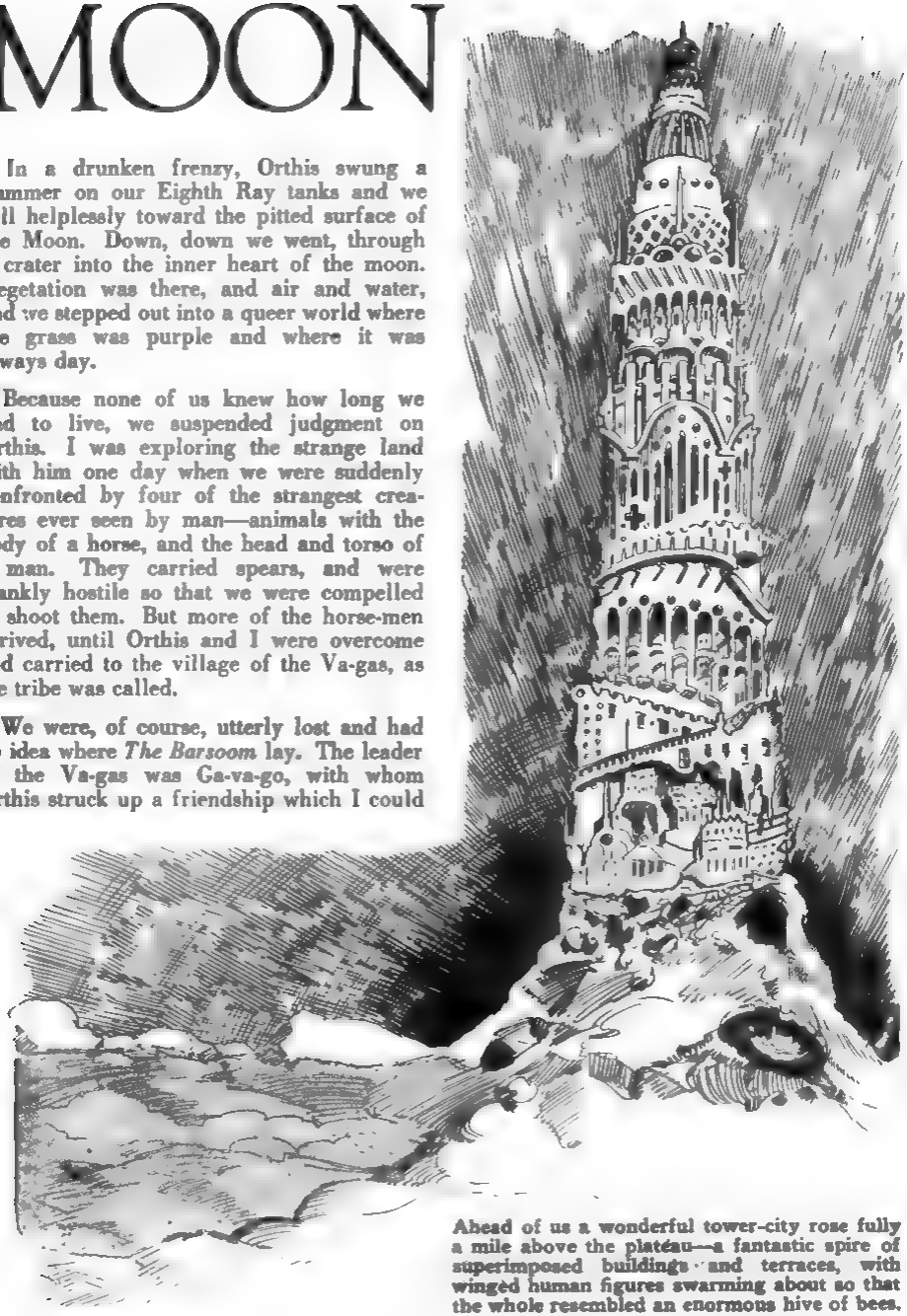
"There," cried Moh-goh, "rises the marvelous Moon city of Laythe."

MOON

In a drunken frenzy, Orthis swung a hammer on our Eighth Ray tanks and we fell helplessly toward the pitted surface of the Moon. Down, down we went, through a crater into the inner heart of the moon. Vegetation was there, and air and water, and we stepped out into a queer world where the grass was purple and where it was always day.

Because none of us knew how long we had to live, we suspended judgment on Orthis. I was exploring the strange land with him one day when we were suddenly confronted by four of the strangest creatures ever seen by man—animals with the body of a horse, and the head and torso of a man. They carried spears, and were frankly hostile so that we were compelled to shoot them. But more of the horse-men arrived, until Orthis and I were overcome and carried to the village of the Va-gas, as the tribe was called.

We were, of course, utterly lost and had no idea where *The Barsoom* lay. The leader of the Va-gas was Ga-va-go, with whom Orthis struck up a friendship which I could



Ahead of us a wonderful tower-city rose fully a mile above the plateau—a fantastic spire of superimposed buildings and terraces, with winged human figures swarming about so that the whole resembled an enormous hive of bees.

not understand at the time, but which later made me wish that I had run my treacherous companion through the heart with one of the Va-gas' swords.

We were standing in the open one day, following a severe lunar storm in which tremendous thunderclaps and rolling balls of fire spread terror among the Va-gas, when I chanced to notice something fluttering in the air at which I at first took to be a bird. Flesh-eaters and cannibals, the Va-gas clustered around under the spot where the exhausted flying creature must drop, ready to pounce upon it and rend it to pieces.

To my horror I saw that it was a human creature with wings joined to a hump on its back. As I watched, it came to earth and the Va-gas wrenched the wings from the poor creature's body.

"Flesh, flesh!" they growled. "We are hungry—give us flesh!"

But Ga-va-go paid no attention to them, standing to one side beneath a tree awaiting the prisoner they were bringing toward him.

The Winged Maiden

ORTHIS, who was becoming the almost constant companion of the chief, was standing beside the latter, while I was twenty-five or thirty yards away, and directly between Ga-va-go and the warriors who were approaching with the prisoner, who would of necessity have to pass close beside me. I remained where I was, therefore, in order to get a better look at it, which was rather difficult because it was almost entirely surrounded by No-vans. However as they came opposite me, there was a little break momentarily in the ranks, and I had my first opportunity for a closer observation of the captive; and my comprehension was almost staggered by what my eyes revealed to me, for there before me was as perfectly formed a human female as I had ever seen.

By earthly standards, she appeared a girl of about eighteen, with hair of glossy blackness, and a skin of almost marble whiteness, slightly tinged with a creamy shade. Only in the color of her skin did she differ from earthly women in appearance, except that she seemed far more beautiful than they. Such perfection of features seemed almost unbelievable. She fairly radiated life and feeling. If my first impression had been startling, it was nothing to the effect that was produced when she turned her eyes upon me. Her black brows were two thin, penciled arches, beneath which were dark wells of light, vying in blackness with her raven hair. She half-turned her head as she was dragged past, that she might have a further look at me, for doubtless she was as surprised to see a creature like me as I was to see her.

Involuntarily I started forward. Whether there was an appeal for succor in those eyes I do not know, but at least they aroused within me instantly, that natural instinct of a human male to protect the weak. And so it was that I was a little behind her and to her right, when she was halted before Ga-va-go.

The savage Va-gas' chieftain eyed her coldly.

"From whence come you, U-ga?" he demanded.

Her head was high, and she eyed him with cold dignity as she replied, "from Laythe."

The No-van raised his brows. "Ah," he breathed, "from Laythe. The flesh of the women from Laythe is good," and he licked his thin lips.

The girl narrowed her eyes, and tilted her chin a bit higher. "Rympth!" she ejaculated, disgustedly.

As rympth is the name of the four-legged snake of Vanah, the inner lunar world, and considered the lowest and most disgusting of created things, she could not well have applied a more opprobrious epithet to the No-van chieftain.

"Your name?" he asked.

"Nah-ee-lah," she replied.

"Nah-ee-lah," he repeated. "Ah, you are the daughter of Sagroth, Jemadar of Laythe."

She nodded in indifferent affirmation, as though anything he might say was a matter of perfect indifference to her.

"What do you expect us to do with you?" asked Ga-va-go, a question which suggested a cat playing with a mouse before destroying it.

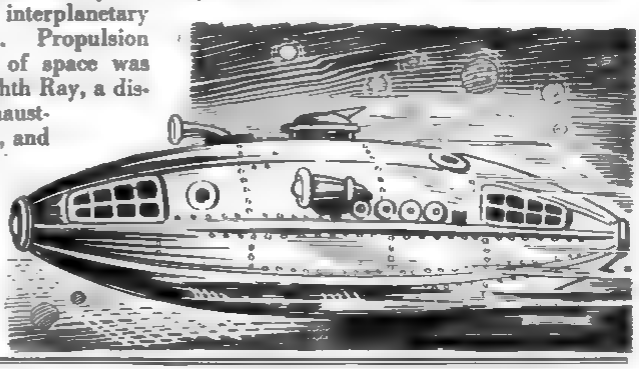
"What can I expect of the Va-gas, other than that they will kill me and eat me?" she replied.

A roar of savage assent arose from the creatures surrounding her. Ga-va-go flashed a quick look of anger and displeasure at his people.

Marvelous Air Ship Carries Julian to the Moon

THE journey to the heart of the moon, described in this thrilling serial by Edgar Rice Burroughs, was made possible by the invention of a wonderful interplanetary cruiser called the *Barsoom*. Propulsion through the cold immensity of space was gained through use of the Eighth Ray, a discharge of electrical energy exhausted by all the heavenly bodies, and which required only to be harnessed by the marvelous Eighth Ray tanks of the *Barsoom* in order to send the steel ship to any spot in the universe.

Don't fail to read this startling story of the adventures of Julian and Nah-ee-lah the Moon Maid in Va-nah, the marvelous lunar country which exists under the crust of the Moon.



"Do not be too sure of that," he snapped. "This be little more than a meal for Ga-va-go alone. It would but whet the appetite of the tribe."

"There are two more," suggested a bold warrior, close beside me, pointing at me and at Orthis.

"Silence!" roared Ga-va-go. "Since when did you become chief of the No-vans?"

"We can starve without a chief," muttered the warrior who had spoken, and from two or three about him arose grumblings of assent.

Swift, at that, Ga-va-go reared upon his hind feet, and in the same motion, drew and hurled his spear, the sharp point penetrating the breast of the malcontent, piercing his heart. As the creature fell, the warrior closest to him slit his throat, while another withdrew Ga-va-go's spear from the corpse, and returned it to the chief.

"Divide the carcass among you," commanded the chief, "and whosoever thinks that there is not enough, let him speak as that one spoke, and there shall be more flesh to eat."

Thus did Ga-va-go, chief of the No-vans, hold the obedience of his savage tribesmen. There was no more muttering then, but I saw several cast hungry eyes at me—hungry, angry eyes that boded me no good.

The Maid From Laythe

NOW Ga-va-go sent scouts far in advance of the point, for we were entering territory which he had not invaded for a long time. Naturally quarrelsome and disagreeable, the No-vans were far from pleasant companions upon that memorable march. I imagine that none, other than Ga-va-go, could have held them. What his purpose was in preserving the three prisoners, that would have made such excellent food for the tribe, I did not know.

Orthis was riding ahead with Ga-va-go, who as usual led the point, while the new prisoner astride a No-van warrior was with the main body, as was I.

Once the warriors that we bestrode paced side by side, and I saw the girl eyeing me questioningly. She seemed much interested in the remnants of my uniform, which must have differed greatly from any clothing she had seen in her own world. It seemed that she spoke and understood the same language that Ga-va-go used, and so at last I made bold to address her.

"Tell me, please," I asked, "how you came to the spot where you were captured, how you flew, and what became of your wings, and why, when they tore them from you, it did not injure you?"

Wings of the U-gas

SHE laughed at that quite merrily.

"The wings do not grow upon us," she explained, "we make them and fasten them upon our arms."

"Then you can support yourself in the air with wings fastened to your arms?" I demanded, incredulously.

"Oh, no," she said, "the wings we use simply for propelling ourselves through the air. In a bag, upon our backs, we carry a gas that is lighter than air. It is this gas which supports us, and we carry it in such quantities as to maintain a perfect equilibrium, so that we may float at any altitude, or with our wings rise or fall gently; but as I hovered over Laythe, came the air that runs, and seizing me with its strong arms bore me off across the surface of Va-nah. Futilely I fought against it until I was spent and weak, and then it dropped me into the clutches of the Va-gas, for the gas in my bag had become depleted. It was not intended to carry me aloft for any great length of time."

Our conversation was suddenly interrupted by a messenger from the point, who came racing back at tremendous speed, carrying word from Ga-va-go that the scouts were signaling that they had discovered a large village, and that the warriors were to prepare to fight.

Immediately we moved up rapidly to Ga-va-go, and then we all advanced toward the scout who could be seen upon a knoll far ahead. We were cautioned to silence, and as we moved at a brisk canter over the soft, pale lavender vegetation of the inner Moon, the feet of the Va-gas giving forth no sound, the picture presented to my earthly eyes was weird and mysterious in the extreme.

When we reached the scout, we learned that the village was situated just beyond a low ridge not far distant, so Ga-va-go gave orders that the women, children, and the three prisoners should remain under a small guard where we were until they had topped the ridge, when we were to advance to a position where we might overlook the village, and if the battle was against the No-vans we could retreat to a point which he indicated to the warriors left to guard us. This was to be the rendezvous, for following defeat the Va-gas warriors scatter in all directions, thus preventing any considerable body of them being attacked and destroyed by a larger body of the pursuing enemy.

Battle of the No-vans

PRESENTLY we saw our force disappear beyond the ridge, and then we too advanced, and as we moved forward there came suddenly to us from the distance the fierce and savage war cry of the No-vans and a moment later it was answered by another no less terrible, rising from the village beyond the ridge. Our guards hastened us then to greater speed, until, at a full run, we mounted the steep slope of the ridge and halted upon its crest.

The ferocity of the scene below us was almost indescribable. The No-van warriors were circling the village at a rapid run, attempting to keep the enemy in a compact mass within, where it would present a better target for their spears. Already the ground was dotted with corpses. There were no wounded, for whenever one fell the nearest to him whether friend or foe cut his throat, since the victors would devour them all without partiality.

Following several unsuccessful attempts to break through the ring of savage foemen the defenders suddenly formed another smaller ring within, and moving in the opposite direction to the No-vans, raced in a rapid circle. No longer did they cast spears at the enemy, but contented themselves with leaping and bounding at a rapid gait. At first it seemed to me that they had lost their heads with terror, but at last I realized that they were executing a strategic maneuver which demonstrated both cunning and high discipline. In the earlier stages of the battle each side had depended for its weapons upon those hurled by the opposing force, but now the defenders hurled no weapons, and it became apparent that the No-vans would soon no longer have spears to cast at them. The defenders were also lessening their casualties by moving in a rapid circle in a direction opposite to that taken by the attackers.

Ga-va-go apparently was familiar with the ruse, for suddenly he gave a loud cry which was evidently a command. Instantaneously, his entire force wheeled in their tracks and raced in the opposite direction paralleling the defenders of the village, and immediately thereafter cast their remaining spears at comparatively easy targets.

"It is almost over," remarked the warrior at my side. "See, there are two or three No-vans now attacking each Lu-than."

The carnage was frightful—Ga-va-go and his No-vans leaped in upon the enemy and the battle became a fierce and bloody hand to hand conflict in which daggers and fangs and three-toed paws were ferocious weapons of offense. No quarter was given—and none expected.

It was true, and I saw that the battle could last but a short time. As a matter of fact it ended almost immediately, the remaining Lu-thans suddenly attempting to break away and scatter in different directions. Some of them succeeded in escaping, possibly twenty, but I am sure that there were not more than that, and the rest fell.

We were summoned now, and as we filed down into the village, great was the rejoicing of our females and young.

After occupying the new village, Orthis and I were separated, he being assigned a hut close to Ga-va-go, while I was placed in another section of the village. If I could have been said to have been on good terms with any of the terrible creatures of the tribe, it was with the woman who had taught me the language of the Va-gas, and it was from her that I learned why Orthis was treated with such marked distinction by Ga-va-go, whom, it seemed, he had

promised to lead to the land of our origin, where, he had assured the savage chieftain, he would find flesh in abundance.

Nah-ee-lah was confined in still another part of the village, and I only saw her occasionally, for it was evident that Ga-va-go wished to keep the prisoners separated. Upon one occasion when I met her at the shore of the lake I asked her why it was that they had not slain and eaten her, and she told me that when Ga-va-go had discovered her identity, and that her father was a Jemadar, a ruler of a great city, he had sent messengers with an offer to return Nah-ee-lah for a ransom of one hundred young women of the city of Laythe.

"Do you think your father will send the ransom?" I asked.

"I do not know," she replied. "I do not see how they are going to get a message to him, for ordinarily, my race kills the Va-gas on sight. They may succeed, however, but even so, it is possible that my father will not send the ransom. I would not wish him to. The daughters of my father's people are as dear to them, as am I to him. It would be wrong to give a hundred of the daughters of Laythe in return for one, even though she be the daughter of the Jemadar."

A Clash With Orthis

WE HAD left the forest and were returning to the village to our huts when, near the large hut occupied by Ga-va-go, we came suddenly upon Orthis. At the sight of us together he scowled.

"If I were you," he said to me, "I would not associate with her too much. It may arouse the displeasure of Ga-va-go."

It was the first time that Orthis had spoken to me since we had occupied this village. I did not like his tone or his manner.

"You will please to mind your own business, Orthis," I said to him, and continued on with Nah-ee-lah. I saw the man's eyes narrow malignantly, and then he turned, and entered the hut of Ga-va-go, the chief of the No-vans.

Every time I went to the river, I had to pass in the vicinity of Nah-ee-lah's hut. It was a little out of my way, but I always made the slight detour in the hope of meeting her, though I had never entered her hut nor called for her, since she had never invited me and realizing her position, I did not wish to intrude.

It chanced that the next time I walked down to the lake shore, following our stroll in the woods, I made my usual detour that I might pass by the hut of Nah-ee-lah. As I came near I heard voices, one of which I recognized as that of Nah-ee-lah, and the other, a man's voice. The girl's tones were angry and imperious.

"Leave my presence, creature!" were the first words that I could distinguish, and then the man's voice.

"Come," he said, ingratiatingly. "Let us be friends. Come to my hut, and you will be safe, for Ga-va-go is my friend." The voice was the voice of Orthis.

"Go!" she ordered him again. "I would as soon lie with Ga-va-go as with you."

"Know, then," cried Orthis, angrily, "that you will go, whether you wish it or not, for Ga-va-go has given you to me. Come!" and then he must have seized her, for I heard her cry out, "How dare you lay hands upon me, Nah-ee-lah, princess of Laythe!"

I was close beside the entrance to the hut now, and I did not wait to hear any more, but thrusting the hanging aside entered. There they were, in the center of the single room, Orthis struggling to drag the girl toward the opening while she resisted and struck at him. Orthis' back was toward me and he did not know that there was another in the hut until I had stepped up behind him and grasping him roughly by the shoulder, had jerked him from the girl and swung him about facing me.

"You cad," I said; "get out of here before I kick you out, and don't ever let me hear of you molesting this girl again."

His eyes narrowed, and he looked at me with an ugly light in them. "Since boyhood, you have cheated me out of all that I wished. You ruined my life on earth, but now, conditions are reversed. The tables are turned. Believe me, then, when I tell you that if you interfere with me you sign your own death warrant. It is only by my favor that you live at all. If I gave the word Ga-va-go would destroy you at once. The woman is mine. Ga-va-go has given her to me. Even if her father should fail to send the ransom her life shall be spared as long as I desire her. Your interference can only result in your death, and do her no good."

"You have heard him," I said, turning to the girl. "What are your wishes in the matter? Perhaps he speaks the truth."

"I have no doubt but that he speaks the truth," she replied, "but know, strangers, that the honor of a princess of Laythe is dearer than her life."

"Very well, Orthis," I said to the man. "You have heard her. Now get out."

He was almost white with anger, and for a moment I thought that he was going to attack me, but he was ever a coward, and contenting himself with giving me a venomous look, he walked from the hut without another word.

I Lose the Moon Maid

I TURNED to Nah-ee-lah, after the hanging had dropped behind Orthis. "It is too bad," I said, "that with all your suffering at the hands of the Va-gas, you should also be annoyed by one who is practically of your own species."

"You are very good," she said. "You are like the better men of Laythe, the high nobles of the court of the Jemadar, Sagroth, my father. They too are honorable men, to whom a woman may look for protection, but there are no others in all Va-nah since the Kalkars arose thousands of kelds ago, and destroyed the power of the nobles and the Jemadars, and all the civilization that was Va-nah's. Only in Laythe, have we preserved a semblance of the old order. I wish I might take you to Laythe, for there you would be safe and happy. You are a brave man. It is strange that you are not married."

I was upon the point of making some reply, when the hangings at the doorway parted, and a No-van warrior entered. Behind him were three others. They were walking erect, with drawn spears.

I grasped Orthis roughly by the shoulder, jerked him from the girl, and swung him about to face me. "You cad!" I cried. "Get out of here before I kick you out!"

"Here he is," said the leader, and then, addressing me, "Come!"

"Why?" I asked. "What do you want of me?"

"Is it for you to question," he demanded, "when Ga-va-go commands?"

"He has sent for me?" I asked.

"Come!" repeated the leader, and an instant later they had hooked their spears about my arms and neck and none too gently they dragged me from the hut. I had something of a presentiment that this was to be the end. At the door-way I half turned to glance back at the girl. She was standing wide-eyed and tense, watching them drag me away.

"Good-bye—Julian," she said. "We shall never meet again for there is none to carry our souls to a new incarnation."

"We are not dead yet," I called back, "and remember if you need me call me," and then the hanging dropped behind us, and she was shut off from my vision.

They did not take me to my own hut, but to another, not far distant from Nah-ee-lah's, and there they bound my hands and feet with strips of leather and threw me upon the ground. Afterwards they left me, dropping the hanging before the entrance.

The Va-gas obtain their leather by curing the hides of their dead. The better portions they use for their trappings and harness. The other portions they cut into thin strips, which they use in lieu of rope. Most of this is very strong, but some of it is not, especially that which is improperly cured.

Escape

THE warriors who had been sent to seize me had scarcely left the hut before I commenced working with my bonds in an attempt to loosen or break them. I exerted all my strength in the effort, until I became sure that those which held my hands were stretching. I do not know how long I worked at them, but it must have been a very long time before I became convinced that however much they gave they were not going to break. Just what I intended to do with my freedom I do not know, since there was little or no chance that I might escape from the village. Perpetual daylight has its disadvantages, and this was one of them, that there was no concealing nocturnal darkness during which I might sneak away from the village unseen.

As I lay resting after my exertions, I suddenly became aware of a strange, moaning sound from without, and then the hut shook, and I realized that another storm had come. Soon after I heard the beat of rain drops on the roof, and then a staggering, deafening peal of lunar thunder. As the storm waxed in violence, I could imagine the terror of the No-vans, nor even in my plight could I resist the desire to smile at their discomfiture. I knew that they must all be hiding in their huts, and again I renewed my efforts to break the bonds at my wrists, but all to no avail; and then suddenly, above the moaning of the wind and the beating of the rain, there came distinctly to my ears in a clear, full voice, a single word: "Julian!"

"Nah-ee-lah," I thought. "She needs me. What are they doing to her?" There flashed quickly before my mental vision a dozen scenes, in each of which I saw the divine figure of the Moon Maid, the victim of some fiendish brutality. I have always been accounted a powerful man, but in the instant that that sweet voice came across the storm to find me, and my imagination pictured her in the clutches of Orthis, something within moved me to Herculean efforts far transcending aught that I had previously achieved. As though they had been cotton twine now, the leather bonds at my wrists snapped asunder, and an instant later those at my ankles were torn away, and I was upon my feet.

I sprang to the door and into the open, where I found myself in a maelstrom of wind and rain. In two bounds I had cleared the space between the hut in which I had been confined and that occupied by Nah-ee-lah, had torn the hanging aside, and had sprung into the interior; and there I beheld the materialization of my last vision—there was Orthis, one arm about the slender body of the girl pinning her arms close to her side, while his other hand was at her throat, choking her and pressing her slowly backward across his knees toward the ground.

He was facing the door this time, and saw me enter, and as he realized who it was, he hurled the girl roughly from him and rose to meet me. For once in his life he seemed to know no fear, and I think that with his passion for the girl, and the hatred he felt for me, and the rage that my interference must have engendered, he was momentarily insane, for he suddenly leaped

upon me like a madman, and for an instant I came near going down beneath his blows—but only for an instant, and then I caught him heavily upon the chin with my left fist, and again, full in the face with my right, and though he was a splendid boxer, he was helpless in my hands.

Neither of us had a weapon, or one of us certainly would have been killed in short order. As it was I tried to kill him with my bare fists, and at last, when he had fallen for the dozenth time, and I had picked him up and held him upon his feet and struck him repeatedly again and again, he no longer moved I was sure that he was dead, and it was with a feeling of relief and of satisfaction in a duty well performed that I looked down upon his lifeless body. Then I turned to Nah-ee-lah.

"Come," I said, "there has been given to us this chance for escape. The Va-gas will be hiding in their huts, crouching in terror of the storm. I do not know whither we may fly, but wherever it be, we can be in no greater danger than we are here."

In the Moon Mountains

NAH-EE-LAH and I passed through the village of the No-vans undetected, since the people of Ga-va-go were cowering in their huts, terror-stricken by the storm. The girl led me immediately to high ground and upward along a barren ridge toward the high mountains in the distance. I could see that she was afraid though she tried to hide it from me, putting on a brave front that I was sure she was far from feeling. My respect for her increased, as I have always respected courage, and I believe that it requires the highest courage to do that which fills one with fear.

The rain and wind must have persisted for a considerable time, for when it was finally over and we looked back through a clear atmosphere we found that a low range of mountains lay between us and the distant sea. We had crossed these and were upon a plateau at the foot of the higher peaks. The sea looked very far away indeed, and we could not even guess at the location of the No-vans village from which we had escaped.

"Do you think they will pursue us?" I asked her.

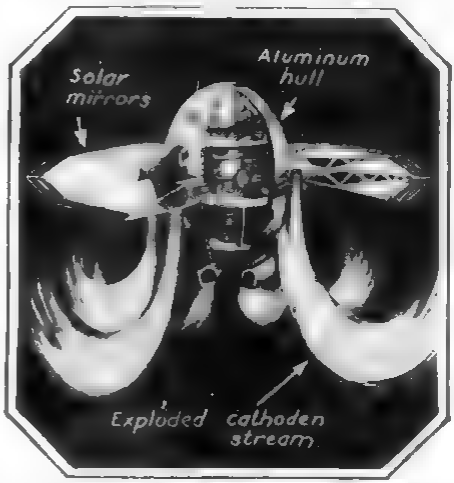
"Yes," she said; "they will try to find us, but it will be like looking for a raindrop in the ocean. They are creatures of the lowlands—I am of the mountains. Down there," and she pointed into the valley, "they might find me easily, but in my own mountains—no."

"We are near Laythe?" I asked.

"I do not know. Laythe is hard to find—it is well hidden. It is for this reason that it exists at all. Its founders were pursued by the Kalkars, and had they not found an almost inaccessible spot they would have been discovered and slain long

Austrian Builds Barsoom

READERS of MODERN MECHANICS who have been following Edgar Rice Burroughs' thrilling story of the flight to the Moon, of the marvelous interplanetary cruiser *Barsoom* will be interested in the accompanying photograph of a sun-ray airship designed by an Austrian engineer, Franz von Ulinski. He calls his machine the "Cathoden Rocket." It obtains its motive power from the sun's rays, which are absorbed by brilliant solar mirrors which form the wings of the ship. Cathode rays loosed by the action of this heat will propel the airship through space, it is claimed.



International Newsreel

before they could have constructed an impregnable city."

She led me then straight into the mighty mountains of the Moon, past the mouths of huge craters that reached through the lunar crust to the surface of the satellite, along the edges of yawning chasms that dropped sheer into frightful gorges, and then out upon vast plateaus, but ever upward toward the higher peaks that seemed to topple above us in the distance.

Nah-ee-lah told me that the secret entrance to Laythe lay just below the lip of one of these craters, and it was this she sought. To me the quest seemed hopeless, for as far as the eye could reach lay naught but an indescribable jumble of jagged peaks, terrific gorges and bottomless craters. Yet always the girl seemed to find a way among or about them—instinctively, apparently, she found trails and footholds where there were no trails and where a chamois might have been hard put to it to find secure footing.

Attacked by the Tor-ho

IN THESE higher altitudes we found a vegetation that differed materially from that which grew in the lowlands. Edible fruits and berries were, however, still sufficiently plentiful to keep us reasonably well supplied with food. When we were tired we usually managed to find a cave in which we could rest in comparative security, and when it was possible to do so Nah-ee-lah always insisted upon barricading the entrance with rocks, since there was always the danger, she told me, of our being attacked by tor-hos.

These bloodthirsty creatures while rare, were nevertheless very much to be feared, since not only were they voracious meat eaters and of such a savage disposition that they attacked nearly everything they saw in wanton ferocity, but even a minor wound inflicted by their fangs or talons often proved fatal, because of the fact that their principal diet was the poisonous flesh of the rympth and the flying toad.

I never saw such a sanguine and hopeful person as Nah-ee-lah. It was her constant belief that Laythe lay just beyond the next mountain, in spite of the fact that she was invariably mistaken—which seemed never to lessen the exuberance of her enthusiasm for the next guess.

Once just after we had rounded the shoulder of a mountain we came upon a little strip of level land clinging to the side of a mighty peak. I was in the lead—a position which I tried always to take when it was not absolutely necessary for Nah-ee-lah to go ahead in order to find a trail. As I came around the shoulder of the mountain, and in full sight of the little level area, I was positive that I saw a slight movement among some brushes at my right about halfway along one side of the little plain.

As we came abreast of the spot, upon which I kept my eye, there broke upon our ears the most hideous scream that I have ever heard, and simultaneously there leaped from the concealment of the brushes a creature about the size of a North American mountain lion, though quite evidently a reptile and probably a tor-ho, as such it proved to be. There was something about the head and face which suggested the cat family to me, yet there was really no resemblance between it and any of the earthly felines.

Nah-ee-lah grasped my arm. "Run!" she cried, "run." But I shook her loose and stood my ground. I wanted to run, that I will admit, but where to? The creature was covering the ground at tremendous speed and our only avenue of escape was the narrow trail over which we had just come, which clung precariously to the side of a perpendicular cliff. And so I stood there waiting, my feeble stick grasped in both hands. Just what I expected to do with it I scarcely knew until the tor-ho was upon me. Then I swung for its head as a batter swings for a pitched ball. I struck it square upon the nose—a terrific blow that not only stopped it, but felled it. I could hear the bones crushing beneath the impact of my crude weapon and I thought that I had done for the thing with that single blow, but I did not know the tremendous vitality of the creature. Almost instantly it was up and at me again, and again I struck it, this time upon the side of the head, and again I heard bones crush and again it fell heavily to the ground.

The Tunnel of Laythe

WHAT appeared to be cold blood was oozing slowly from its wounded face as it came at me for the third time, its eyes glaring hideously, its broken jaws agape to seize me, while its shrieks and moans rose to

a perfect frenzy of rage and pain. It reared up and struck at me with its talons now, but I met it again with my bludgeon and this time broke a fore leg.

How long I fought with that awful thing I cannot even guess. Time and time again it charged me furiously and each time, though often by but a miracle of fortune, I managed to keep it from closing, and each blow that I delivered crushed and maimed it a little more, until at last it was nothing but a bleeding wreck of pulp, still trying to crawl toward me upon its broken legs and seize me and drag me down with its broken, toothless jaws. Even then it was with the greatest difficulty that I killed it, that I might put it out of its misery.

Rather exhausted, I turned to look for Nah-ee-lah, and much to my surprise, I found her standing directly behind me.

"I thought you had run away," I said.

"No," she said, "you did not run and so I did not, but I never thought that you would be able to kill it."

"You thought that it would kill me, then?" I asked.

"Certainly," she replied. "Even now I cannot understand how you were able to overcome a tor-ho with that pitiful little stick of wood."

"But if you thought I was going to be killed," I insisted, "why was it that you did not seek safety in flight?"

"If you had been killed I should not have cared to live," she said simply.

I did not exactly understand her attitude and scarcely knew what reply to make.

"It was very foolish of you," I said at last, rather blunderingly, "and if we are attacked again you must run and save yourself."

I was rather tired out after my encounter with the tor-ho and should have liked to stop for a rest, but I did not suggest it, neither did Nah-ee-lah, and so we continued on our seemingly interminable way, though, almost exhausted as I was, I dropped some little distance behind my beautiful guide.

She was quite out of sight ahead of me upon the winding trail when suddenly I heard her calling my name aloud. I answered her as, simultaneously, I broke into a run, for I did not know but what she might be in danger, though her voice did not sound at all like it. She was only a short distance ahead and when I came in sight of her I saw her standing at the edge of a mighty crater. She was facing me and she was smiling. "Oh, Julian," she cried, "I have found it. I am home and we are safe at last."

"You are quite sure that this is the crater where lies the entrance to Laythe?" I asked her.

"There is no doubt of it, Julian," she replied, and she pointed downward over the lip of the crater toward a narrow ledge which lay some twenty feet below and upon which I saw what appeared to be the mouth of a cave opening into the crater.

"But, how are we going to reach it?" I asked.

"It may be difficult," she replied, "but we will find a way."

"I hope so, Nah-ee-lah," I said, "but without a rope or wings I do not see how we are going to accomplish it."

Into the Abyss

"IN THE mouth of the tunnel," explained Nah-ee-lah, "there are long poles, each of which has a hook at one end. Ages ago there were no other means of ingress or egress to the city and those who came out to hunt or for any other purpose came through this long tunnel from the city, and from the ledge below they raised their poles and placed the hooked ends over the rim of the crater, after which it was a simple matter to clamber up or down the poles as they wished; but it has been long since these tunnels were used by the people of Va-nah, who had no further need of them after the perfection of the flying wings which you saw me using when I was captured by the Vagas."

"If they used poles, so may we," I said, "since there are plenty of young trees growing close to the rim of the crater. The only difficulty will be in felling one of them."

"We can do that," said Nah-ee-lah, "if we can find some sharp fragments of stone. It will be slow work, but it can be done," and she started immediately to hunt for a fragment with a cutting edge. I joined her in the search and it was not long before we had discovered several pieces of obsidian with rather sharp edges. We then started to work upon a young tree about four inches in diameter that grew almost straight for a height of some thirty feet.

Cutting the tree down with our bits of

lava glass was tedious work, but finally it was accomplished, and we were both much elated when the tree toppled and fell to the ground. Cutting away the branches occupied almost as long a time, but that, too, was finally accomplished. The next problem which confronted us was that of making the top of the pole secure enough to hold while we descended to the ledge before the mouth of the tunnel. We had no rope and nothing with which to fashion one, other than my garments, which I was loth to destroy, inasmuch as in these higher altitudes it was often cold. Presently, however, I hit upon a plan, which, if Nah-ee-lah's muscles and my nerves withstood the strain it put upon them, bade fair to assure the success of our undertaking. I lowered the larger end of the pole over the side of the crater until the butt rested upon the ledge before the mouth of the tunnel. Then I turned to Nah-ee-lah.

"Lie down flat at full length, Nah-ee-lah," I directed her, "and hold this pole securely with both hands. You will only have to keep it from toppling to the sides or outward. While you hold it, I will descend to the mouth of the tunnel and raise one of the regular hooked poles which you say should be deposited there. If they are not, I believe that I can hold our own pole securely from below while you descend."

She looked over into the vast abyss below and shuddered. "I can hold it at the top," she said, "if the bottom does not slip from the ledge."

"That is a chance that I shall have to take," I replied, "but I will descend very carefully and I think there will be little danger upon that score."

As I descended very slowly I tried not to think at all, but to exclude from my mind every consideration of the appalling depths beneath me. I could not have been more than two feet from the ledge when the very thing that we both tried so hard to guard against transpired—a splintered fragment of the pole's butt crumpled beneath my weight and that slight jar was just sufficient to start the base of my precarious ladder sliding toward the edge of the narrow projection upon which I had rested it, and beyond which lay eternity. Above me I heard a slight scream and then the pole slipped from the ledge and I felt myself falling.

It was over in an instant. My feet struck the ledge and I threw myself within the mouth of the tunnel. And then, above, I heard Nah-ee-lah's voice crying in agonized tones:

"Julian! Julian! I am falling!"

Nah-ee-lah Is Rescued

INSTANTLY I sprang to my feet and peered upward from the mouth of the tunnel upon a sight that froze my blood, so horrifying did it seem, for there above me, still clinging to the pole, hung Nah-ee-lah, her body, with the exception of her legs, completely over the edge of the crater. Just as I looked up she dropped the pole and although I made a grab for it I missed it and it fell past me into the maw of the crater.

"Julian! Julian! You are safe!" she cried; "I am glad of that. It terrified me so when I thought you were falling and I tried my best to hold the pole, but your weight dragged me over the edge of the crater. Good-bye, Julian, I cannot hold on much longer."

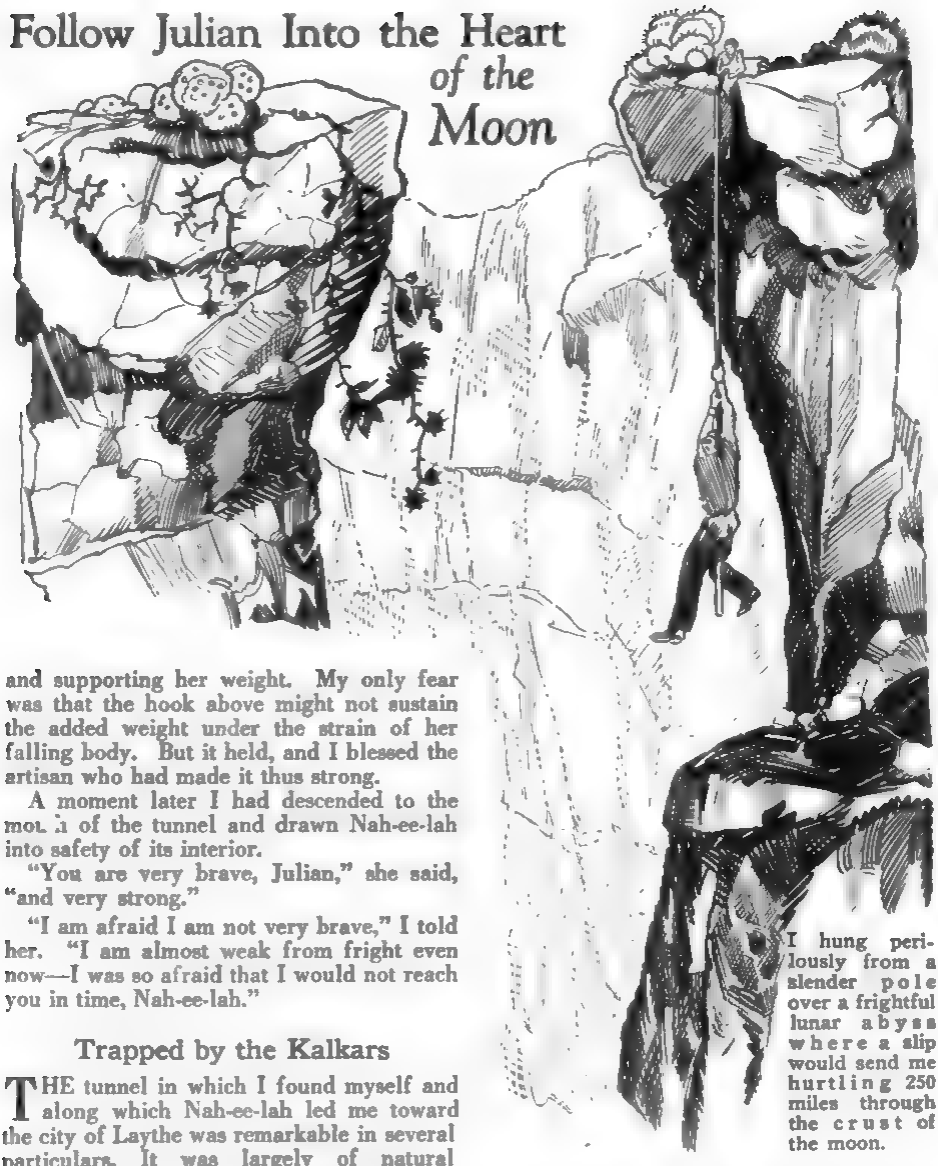
"You must, Nah-ee-lah!" I cried; "do not forget the hooked poles that you told me of. I will find one and have you down in no time." And even as I spoke I turned and dove into the tunnel; but my heart stood still at the thought that the poles might not be there. My first glance revealed only the bare rock of walls and floor and ceiling and no hooked poles in sight. I sprang quickly farther into the tunnel which turned abruptly a few yards ahead of me and just around the bend my eyes gladdened by the sight of a dozen or more of the poles which Nah-ee-lah had described. Seizing one of them, I ran quickly back to the entrance.

"Just a moment more, Nah-ee-lah!" I cried to her, as I raised the pole and caught the hook upon the crater's rim. There were small protuberances on either side of the pole for its entire length, which made climbing it comparatively simple.

"Make haste, Julian!" she cried, "I am slipping."

It wasn't necessary for her to tell me to make haste. I think that I never did anything more quickly in my life than I climbed that pole, but I reached her not an instant too soon, for even as my arm slipped about her, her hold upon the ledge above gave way, and she came down head foremost upon me. I had no difficulty in catching her

Follow Julian Into the Heart of the Moon



I hung perilously from a slender pole over a frightful lunar abyss where a slip would send me hurtling 250 miles through the crust of the moon.

and supporting her weight. My only fear was that the hook above might not sustain the added weight under the strain of her falling body. But it held, and I blessed the artisan who had made it thus strong.

A moment later I had descended to the mou.h of the tunnel and drawn Nah-ee-lah into safety of its interior.

"You are very brave, Julian," she said, "and very strong."

"I am afraid I am not very brave," I told her. "I am almost weak from fright even now—I was so afraid that I would not reach you in time, Nah-ee-lah."

Trapped by the Kalkars

THE tunnel in which I found myself and along which Nah-ee-lah led me toward the city of Laythe was remarkable in several particulars. It was largely of natural origin, seemingly consisting of a series of caves which may have been formed by bubbles in the cooling lava of the original molten flow and which had later been connected by man to form a continuous subterranean corridor.

"It must seem good," I said, "to travel again this familiar tunnel of your native city. I know how happy I should be were I thus approaching my own birthplace."

"I am glad to be returning to Laythe," she said, "for many reasons, but for one I am sorry, and as for this passageway it is scarcely more familiar to me than to you, since I have traversed it but once before in my life and that when I was a little girl and

came here with my father and his court upon the occasion of his periodical inspection of the passageway, which is now practically never used."

"If you are not familiar with the tunnel," I asked, "are you sure that there is no danger of our going astray at some fork or branch?"

"There is but the one passageway," she replied, "which leads from the crater to Laythe."

"And how long is the tunnel?" I asked. "Will we soon enter the city?"

"No," she replied, "it is a great distance from the crater to Laythe."

We had covered some little distance at this time, possibly five or six miles, and she had scarcely ceased speaking when a turn in the passageway led us into a cave of larger proportions than any through which we had previously passed and from the opposite side of which two passageways diverged.

"I thought there were no branches," I remarked.

"I do not understand it," she said. "There is no branch from the tunnel of Laythe."

"Could it be possible that we are in the wrong tunnel?" I asked, "and that this does not lead to Laythe?"

"A moment before I should have been sure that we were in the right tunnel," she replied, "but now, Julian, I do not know, for never had I heard of any branches of our own tunnel."

We had crossed the cave and were standing between the openings of the two divergent passageways.

"Which one shall we take?" I asked, but again she shook her head.

"I do not know," she replied.

"Listen!" I cautioned her. "What was that?" For I was sure that I had heard a sound issuing from one of the tunnels.

We stood peering into an aperture which revealed about a hundred yards of the passageway before an abrupt turn hid the continuation of it from our view. We could hear what now resolved itself into the faint sound of voices approaching us along the corridor, and then quite suddenly the figure of a man appeared around the corner of the turn. Nah-ee-lah leaped to one side out of sight, drawing me with her.

"A Kalkar!" she whispered. "Oh, Julian, if they find us we are lost."

"If there is only one of them I can take care of him," I said.

"There will be more than one," she replied; "there will be many."

"Then, let us return the way we came and make our way to the top of the crater's rim before they discover us. We can throw their hooked poles into the crater, including the one which we use to ascend from the mouth of the tunnel, thus effectually preventing any pursuit."

"We cannot cross this room again to the tunnel upon the opposite side without being apprehended," she replied. "Our only hope is in hiding in this other tunnel until they have passed and trusting to chance that we meet no one within it."

"Come, then," I said. "I dislike the idea of flying like a scared rabbit, but neither would there be any great wisdom in facing armed men without a single weapon of defense."

Pursuit

EVEN as we had whispered thus briefly together, we found the voices from the other tunnel had increased and I thought that I noted a tone of excitement in them.

"That man was a Kalkar," said Nah-ee-lah, "which means that we are in the wrong tunnel and that we must retrace our steps and continue our search for Laythe upon the surface of the ground." Her voice sounded tired and listless, as though hope had suddenly deserted her brave heart.

"Do not despair, Nah-ee-lah," I begged her; "we are no worse off than we have been and much better off than before we escaped the Va-gas of Ga-va-go. Then do you not recall that you mentioned one drawback to your return to Laythe—that you might be as well off here as there? What was the reason, Nah-ee-lah?"

"Ko-tah wants me in marriage," she replied. "Ko-tah is very powerful. He expects one day to be Jemadar of Laythe. This he cannot be while I live unless he marries me."

"Do you wish to marry him?" I asked.

"No," she said; "not now. Before—" she hesitated— "before I left Laythe I did not care so very much; but now I know I cannot wed with Ko-tah."

I was about to reply when she placed slim fingers upon my lips. "Hush, Julian!" she

On their backs the wing-bearing Laytheans wore a double-valved tank which, when inflated with gas, enabled them to float in the lunar air. With their sharp-pronged spears and beating wings, they were formidable creatures for an unarmed man to encounter.

whispered, "they are following us up this corridor. Come quickly, we must escape before they overtake us," and so saying, she turned and ran quickly along the corridor which led neither of us knew whither.

But we were soon to find out, for we had gone but a short distance when we came to the tunnel's end in a large circular chamber, at one end of which was a rostrum upon which were a massive, elaborately carved desk and a chair of similar design. Below the rostrum were arranged other chairs in rows, with a broad aisle down the center. The furniture, though of peculiar design and elaborately carved with strange figures of unearthly beasts and reptiles, was not, for all of that, markedly dissimilar to articles of the same purpose fabricated upon Earth. The chairs had four legs, high backs and broad arms, seeming to have been designed equally for durability, service, and comfort.

I glanced quickly around the apartment, as we first entered, only taking in the details later, but I saw that there was no other opening than the one through which we had entered.

"We will have to wait here, Nah-ee-lah," I said. "Perhaps, though, all will be well—the Kalkars may prove friendly."

She shook her head negatively. "No," she said, "they will not be friendly."

"What will they do to us?" I asked.

"They will make slaves of us," she replied, "and we shall spend the balance of our lives working almost continuously until we drop with fatigue under the cruelest of taskmakers, for the Kalkars hate us of Laythe and will hesitate at nothing that will humiliate or injure us."

She had scarcely ceased speaking when there appeared in the entrance of the cave the figure of a man about my own height dressed in a tunic similar to Nah-ee-lah's but evidently made of leather. He carried a knife slung in a scabbard depending from a shoulder belt, and in his right hand he grasped a slender lance. His eyes were close set upon either side of a prominent, hooked nose. They were watery, fishy, blue eyes, and the hair growing profusely above his low forehead was flaxen in color. His physique was admirable, except for a noticeable stoop. His feet were very large and his gait awkward when he moved. Behind him I could see the heads and shoulders of others. They stood there grinning at us for

a moment, most malevolently, it seemed to me, and then they entered the cave—a full dozen of them. There were several types, with eyes and hair of different colors, the former ranging from blue to brown, the latter from light blond to almost black.

Battle on the Ledge

AS THEY emerged from the mouth of the tunnel they spread out and advanced slowly toward us. We were cornered like rats in a trap. How I longed for the feel of my automatic at my hip! I envied them their slender spears and their daggers. If I could have but these I might have a chance at least to take Nah-ee-lah out of their clutches and save her from the hideous fate of slavery among the Kalkars, for I had guessed what such slavery would mean to her from the little that she had told me, and I had guessed, too, that she would rather die than submit to it.

Several of the Kalkars were coming down the main aisle toward us, and as I turned toward them from speaking to Nah-ee-lah, I raised the chair which my hand had been resting upon, and swinging it quickly around my head hurled it full in the face of the leader. As he went down Nah-ee-lah and I ran forward, gaining a little toward the opening of the tunnel, and then without pausing I hurled another chair and a third and a fourth, in rapid succession. The Kalkars tried to bring us down with their lances, but they were so busy dodging chairs that they could not cast their weapons accurately, and even those few which might otherwise have struck us were warded off by my rather remarkable engines of defense.

Marooned With the Kalkars

THE way before us was temporarily open, while the Kalkars behind us had paused, momentarily, at least, in evident consternation at the havoc I wrought with these unseemly weapons against which they had no defense.

"Halt!" I cried to them, "you see what fate your companions have met, because you would not let us go in peace. That is all we ask. I am armed now and it will be death to any who follow us."

They paused and I saw them whispering together as Nah-ee-lah and I backed along the corridor, a turn in which soon shut them from our view. Then we wheeled and ran like deer along the winding passageway. I did not feel very safe from capture at any time, but at least I breathed a sigh of relief after we had passed the chamber from which the Kalkars had run us into the *cul-de-sac*, and we had seen no sign of any other of their kind. We heard no sound of pursuit, but that in itself meant nothing, since the Kalkars are shod with soft leather sandals, the material for which, like all their other leather trappings, is made of the skins of Va-gas and of the prisoners from Laythe.

As we came to the pile of hooked poles which marked the last turn before the entrance of the tunnel I breathed an inward sigh of relief. Stooping, I gathered them all in my arms, and then we ran on to the opening into the crater, where I cast all but one of the poles into the abyss. That which I retained I hooked over the lip of the crater and then, turning to Nah-ee-lah, I bade her ascend.

"Make haste, Nah-ee-lah," I cried; "they come!"

Climbing a pole is slow work at best, but when one is suspended over the brink of a bottomless chasm and is none too sure of the security of the hook that is holding the pole above, one must needs move cautiously. Yet, even so, Nah-ee-lah scrambled upward so rapidly as to fill me with apprehension for her safety. Nor were my fears entirely groundless, for, standing in the mouth of the tunnel, where I could keep one eye upon Nah-ee-lah and the other toward the turn around which my pursuers would presently come in view, I saw the girl's hands grasp the rim of the crater at the very instant that the hook came loose and the pole dropped past me into the abyss. I might have caught it as it fell, but my whole mind was fixed upon Nah-ee-lah and her grave danger. Would she be able to draw herself upward, or would she fall? I saw her straining frantically to raise her body above the edge of the volcano, and then from up the corridor behind me came an exultant cry and I turned to face a brawny Kalkar who was racing toward me.

Prisoner of Gapth

NOW, indeed, did I have reason to curse the stupidity that had permitted me to cast into the abyss all of the hooked poles save one, since even this one was now lost to me and I was utterly without means of

scaling the wall to escape from the tunnel.

As the fellow approached me at a rapid run I hurled my lance, but being unaccustomed to the weapon, I missed, and then he was upon me, dropping his own lance as he leaped for me, for it was evidently his desire to take me alive and unharmed. I thought that I was going to have him now, for I believed that I was more than a match for him, but there are tricks in every method of attack and this lunar warrior was evidently well schooled in his own methods of offense. He scarcely seemed to touch me, and yet he managed to trip me and push me simultaneously so that I fell heavily backward to the ground and turning a little sideways as I fell, I must have struck my head against the side of the tunnel, for that is the last that I remember until I regained consciousness in the very cave that Nah-ee-lah and I had reached when we saw the first of the Kalkars.

The fellow who had captured me was in very good humor, doubtless because of his success, and when he discovered that I had regained consciousness he started to converse with me.

"You thought that you could escape from Gapth, did you?" he cried, "but never; you might escape from the others, but not from me—no, not from Gapth."

"Although I did not escape this time," I said, "I shall next time."

He laughed a nasty laugh. "There will be no next time," he said, "for we are taking you to the city, and once there, there is no escape, for this is the only avenue by which you can reach the outer world and once within the city you never can retrace your steps to the mouth of the tunnel."

I was not so sure of that, myself, for my sense of direction and that of location are very well developed within me. The degree of perfection attained in orientation by many officers of the International Peace Fleet has been described as almost miraculous, and even among such as these my ability in this line was a matter of comment.

"We do not even have to confine our prisoners," continued Gapth, "after we have so marked them that their ownership may always be determined."

"How do you mark them?" I asked.

"With heated irons we make the mark of the owner here," and he touched my forehead just above my eyes.

"Pleasant," I thought to myself, and then aloud: "Shall I belong to you?"

"I do not know," he replied, "but you will belong to whomever The Twentyfour allot you."

We moved on after we left the cave for a considerable period of time in silence. I was busy making mental notes of every salient feature that might be useful to me in retracing my steps, but I found nothing other than a winding and gently ascending corridor, without crossings or branches, until we reached the foot of a long flight of stone steps at the summit of which we emerged into a large chamber in the walls of which there must have been at least a dozen doorways, where, to my great disappointment, I was immediately blindfolded.

The Kalkar City

I COULD tell when we left the larger chamber and entered the corridor from the different sound which our footsteps made. We advanced along this corridor ninety-seven paces, when we turned abruptly to the right and at the end of thirty-three paces emerged into another chamber, as I could easily tell again from the sound of our footsteps the instant we crossed the threshold.

They removed my blind and we climbed interminable stairways, passed through numerous corridors and chambers, all of which were illuminated by the radium-bearing substance which coated their walls and ceiling, and then we emerged suddenly upon a terrace into the open air, and I obtained my first view of a lunar city. It was built around a crater, and the buildings were terraced back from the rim, the terraces being generally devoted to the raising of garden truck and the principal fruit-bearing trees and shrubs.

Upon my left were the faces of buildings, uniformly two stories in height, with an occasional slender tower rising fifteen, twenty or sometimes as high as thirty feet from the terraced roofs above. It was into one of these buildings that my captors led me after we had proceeded a short distance along the terrace, and I found myself in a large apartment in which were a number of male Kalkars, and at a desk facing the entrance a large, entirely bald man who appeared to be of considerable age. To this person I

(Continued on page 182)

Flying FIRE FIGHTERS

Photos by Courtesy U. S. Forest Service

One airplane can do the work of ten mounted rangers in spotting forest fires. This picture, taken in the Tahoe National Forest, enabled the right number of men to be despatched in the proper direction so that control of the blaze was speedily effected.

Flying three miles high, the Forest Patrol goes forth to fight the dread scourge of the forest fire. Diving through a blinding pall of smoke, this daring branch of the Forest Service organize Uncle Sam's defenses against fires which cause half a billion dollars' damage yearly.

By BERYL DILL

THE adventurous days of flying are not over yet—not by a long shot! Although the day is past when men prayed for windless days to fly and were afraid to go aloft in their bamboo creations unless the smoke of a cigarette would go straight up in the still air, the fact that the superb machines we have today are so reliable does not mean that there is no more adventure to be had in the air!

On the contrary, consider some of the experiences which have happened to the flying soldiers of fortune who patrol the vast wilderness timber resources of the country. Every day these pilots are encountering emergencies which parallel the thrilling incidents which were met by war time fliers. The manner in which these men do their work as well as stories of the freak things which happen to them are as absorbing as many a chapter from the war.

Consider that for a third of a century the Forest Service, which has charge of fire-fighting activities in the national forests, has been improving its tools and methods. But until the end of the World War it was still an earth-bound army. Then came the Army with its staunch 400 horsepower de Havillands, built for combat service.

And with them many of the adventurous men who had been trained to fly during the big struggle across the pond. These men were used to the rigors of a life of rigid discipline fraught with unknown excitement lurking just around the corner, and fitted into the work of patrolling the forests very well. Today, flying far above the smoke blanket, sometimes more than three miles high, the rangers are able to spot new fires, often where lookouts could not see them by

# of UNCLE SAM'S Forests

Sandbags containing reports of fires are dropped to mountain lookouts, who phone details to the Chief Ranger. This beats Paul Revere's method.

Lieut. R. S. Worthington, in command of the Olympic Forest Patrol. Note the fur helmet made from the headskin of a Canada lynx!

reason of intervening ridges.

Citing an example as to how these men work, let us take the case of the forest supervisor who circled a large fire and in an hour's time gathered sufficient data to reorganize the entire plan of attack after he landed. Often the flying rangers stay aloft for two, three, and even six hours at a time, doing six months' work of ordinary patrols. Planes may be equipped with radio compasses, whereby two or more observers below could locate the exact position on their maps of a plane circling over a fire.

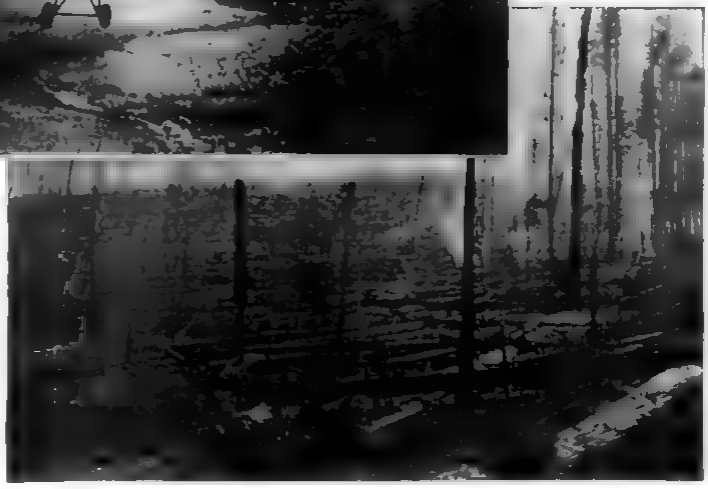
Signalling With Sandbags

Sand and gravity operate one of the most effective signalling systems. The flying observer notes the location of a wisp of smoke, spots it on his map, and describes it on a leaf of his notebook. This leaf he attaches to a bag of sand, and when the plane has zoomed down close to the lookout station, he drops his sand-bag. A long streamer and a puff of dust show how good his aim was.

Messages from the clouds have thus been dropped at the very feet of lookouts. Last year District Ranger Box, flew over the Yreka Ranger District after a severe lightning storm. He discovered a fire which had not been seen by any lookout, and dropped a message at the Dry Lake Lookout Station. Men were on their way to suppress it before the plane landed.

Over thirteen million square miles were observed from 26 California patrols in the first year. The 1,118 trips required only 3,262 hours of actual flight. Most of the fires were spotted within a quarter mile of actual location, and were reported on an average within ten minutes of discovery. In the extremely rugged Lassen district, an hour of aerial observation was found equal to two days' arduous work by a mounted

Forest Fires Destroy Natural Resources



Above is an old wartime DH4, now doing duty in the Forest Service in southern California. At the right is a burnt over area in the Colorado National Forest which is still smouldering. It will take years for this forest land to develop big timber again.

patrolman. In one district 32 fires were reported within two days, creating a critical situation until experienced officers were brought in by airplane.

Although smoke chasing was the original work of these aerial firemen, supplementing the work of lookouts, and the whole Pacific Coast was covered in 1921, the reporting of new fires has now given way to even more important functions. Effective fighting requires knowledge of winds, and also requires photographs and other information which the fire patrol brings in within a short time. Bases along the Pacific Coast, near Seattle, Spokane, Eugene, Oregon, Sacramento and Glendale, California, enable planes to reach any part of the wildest regions within an hour or two at most. Tools and supplies are carried in quickly; telephone wires and blankets have been dropped to fighters in the woods, the planes swooping down almost to the tree tops.

Flames Menace Fliers

Reconnoissance flights are today the most important duty of planes, especially in smoky and foggy weather. Bumps and dangerous down currents are common over mountains, lakes and clumps of trees. Usually a forced landing means a crash. Yet planes have flown directly over large burning fires, even through clouds of thick smoke.

But such flights are discouraged, I was told by S. B. Show, District Forester for California. In making observations on a fire, he said it is necessary to fly quite low, and in a rugged mountainous country in dense smoke there is danger of hitting some high peak. "We try to keep away from flying directly over the flames of fires of any size. A few years ago Lieut. Moseley, of the Air Service, and Forest Supervisor Jordan of the Santa Barbara National Forest, got directly over the large Oso fire on the Santa Ynez River. They had much difficulty in getting out because of the excessive heating of the motor and bad flying conditions.

"In all of our years of flying," he continued, "we have never had a man forced down in forest or brush fields. We employ only pilots who are reserve officers and who have had large experience in handling these planes. The motors are thoroughly overhauled after each 100 hours of flying and each pilot and observer is required to use a seat type parachute. It has never been

necessary for one of our men to make a parachute jump. The Air Mail had several men down in the timber of the Eldorado and Tahoe National Forests, and as we recall it the planes were badly smashed.

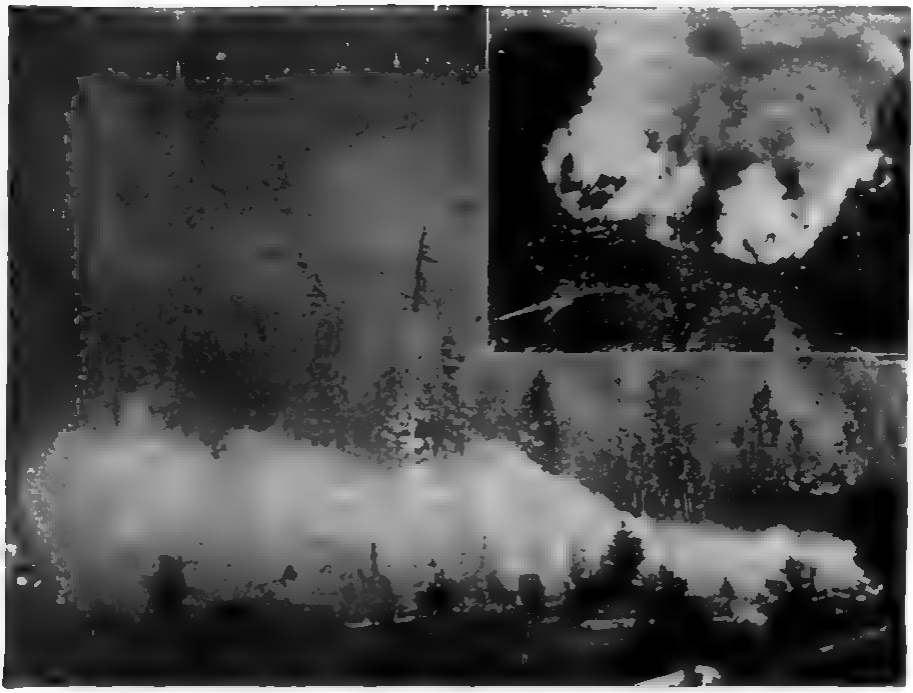
"We believe an expert pilot could get down into a large brushfield without demolishing his plane, but he could not hope to do this in solid timber. Many of the towns in mountain valleys now have landing fields, and we have six emergency fields. So it is often possible for a plane flying over the mountain region to reach one of them in case a motor should start to miss."

Night view of a forest fire photographed by its own light. Note tree in right foreground ready to topple over.

Few natural sites are available for landing in the Cascades and Sierra Nevadas, and while forced landings have been made on mountain meadows, only rarely are they large and clear enough for these big de Havilland ships.

In the northern areas, the writer was told by Howard R. Flint, District Forest Inspector at Missoula, "a few emergency landing fields are available, but they are of much too infrequent occurrence in the rugged areas of Montana, Idaho, Washington and Oregon. There have been no major crashes and only three forced landings in as many years. Fortunately in all of these cases, two of them caused by trouble in the lubrication system of the engine, there was some sort of warning of danger and sufficient time to reach open fields out in the larger valleys. There are plenty of thrills in the work, due chiefly to smoke, thunderstorms, clouds and rough air over the mountains."

Forest Service men are shown running fire lines around a bad blaze in the Wasatch National Forest, Utah. The ground is burned of brush and the flames cannot jump the gap.



The tremendous volume of choking smoke shot skyward by a blazing forest fire is well shown by this picture taken in the Kootenai National Forest, Montana. The insert shows how the fire looks from an airplane flying at an altitude of two thousand feet.

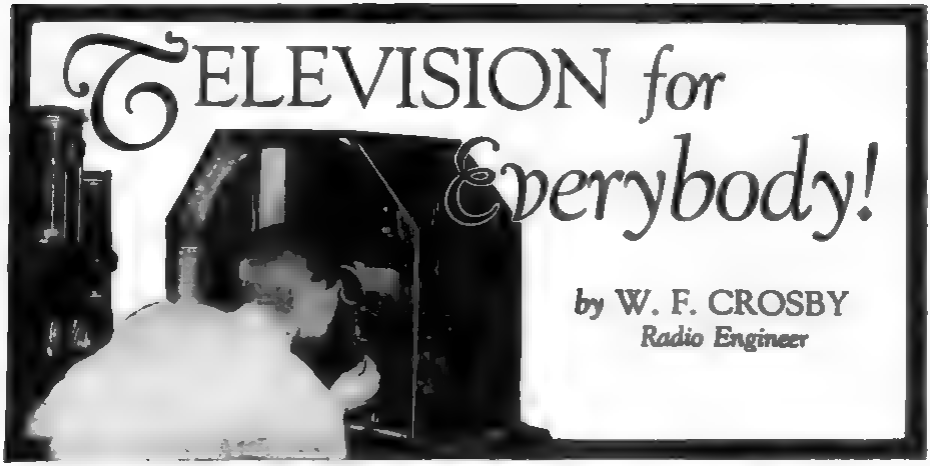
After a violent electric storm in the northern Rockies, in western Montana and northern Idaho, 200 fires may be started in the forests. A swift survey is of utmost importance. As hundreds of men, sometimes a thousand or so, are quickly thrown into the smoking arena of war, with trucks, tank wagons, portable gasoline pumps and other tools, numbers of droning de Havillands circle over the battlefields. Over a thousand fires are thus detected each year in the vast uninhabited areas of Canada.

Seaplanes Used in Lake Country

Many fires are reported by seaplanes in the lake regions. Flying boats have been very successful in regions like Ontario, where men and equipment have been carried hundreds of miles for swift attacks. Michigan, Minnesota and Wisconsin, timber states of by-gone days, are still subject to extensive fires every season.

In addition to timber loss, the fires cause destruction of towns and great loss of life. They often destroy the fertility of burned-over soil. They damage water resources from which many communities draw their water. Irrigation and water power plants suffer because the rainfall and snow are not held in check. Roads, trails, fences and campgrounds are damaged. Grazing lands are impaired. On these lands over 14 million sheep, goats, cattle, horses and swine graze each year, within national forests.

In Uncle Sam's vast domain of growing timber, the flying firemen constitute his first line of defense. Airplanes have been particularly successful in the reconnoissance of large fires, said District Forester Show, and we are very desirous of continuing this excellent service. Perhaps the next step will be flying tankwagons and man-made cloudbursts!



TELEVISION for Everybody!

by W. F. CROSBY
Radio Engineer

NOW THAT regular television broadcasts are coming from New York stations, television fans can have their own picture receiving sets, built as Mr. Crosby outlines them in this complete, simple explanation of the new fad.

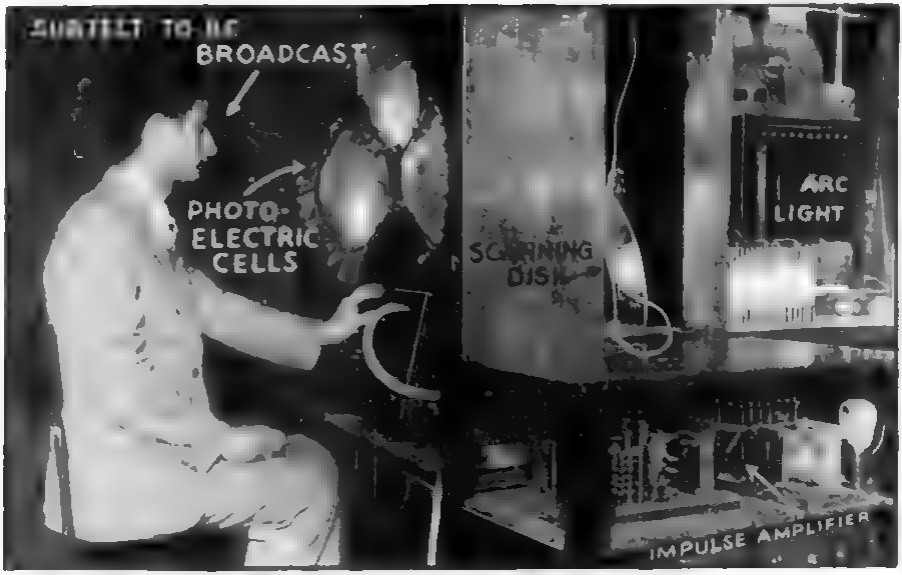
PICTURES of any kind, when sent by radio, must of necessity be somewhat crude as compared with the regular run of motion pictures and magazine illustrations. This is due to several factors, one of them being the fact that each broadcast station is allotted a rather narrow wavelength band and another reason being in the limitations imposed by the nature of the apparatus to be used. However, before going into the subject more deeply, it is necessary to point out the various classifications in order that what follows may be perfectly clear.

There are three classes of pictures, all of which are called "television" by the general public, when in reality the only class that may rightfully be called by this name is the system where the face or figure of the actual subject is picked up and transmitted through the air. Radio-movies are not television because here we have a subject that has been photographed beforehand and the film is then rolled out before the "eye" of the equipment. In this case the equipment may be very similar to the one used in television, but it is actually the transmission of a "canned" picture and not a picture of the subject itself. The third and least important class is that in which the subject is photographed once and a print of this photo is rolled around a drum at the transmitting station. A finger of light, playing over this drum at a predetermined speed transmits this "still" picture over the air to the receiver where a similar drum and a sensitive piece of photographic paper picks up the picture and after a period ranging from two to five minutes, the exposure is completed and the sensitized paper may be then developed in the usual photographic way. Obviously, this is far from television.

Television Now Broadcast

One of the New York broadcasting stations (WRNY), has recently started to broadcast television impulses regularly on a wavelength of 326 meters and also through 2 XAL on a wavelength of 30.91 meters. These signals will be broadcast for the first five minutes of every hour that these two stations are on the air and if there is a sufficient demand by experimenters, the stations will transmit longer periods after midnight.

The writer of this article was present at the inauguration of the system where, after brief speeches by the sponsors of the development, an actual demonstration of the



Here is shown the television broadcasting equipment. The subject to be broadcast sits in front of three photo-electric cells, which are shown in the picture covered with fine metallic gauze. These cells are used in changing the light waves into electric impulses which can be sent by wireless.

receiver was given, the televised subject being received by radio over a distance of some five or six miles.

The system is one employing actual television. By this it is meant that the subject seen in the receiving equipment is actually seated or standing before the equipment at the transmitter, but due to the restrictions of the broadcasting channels at present, it is not possible to transmit both voice and face at the same time unless two separate transmitters and receivers are used, the transmitters operating on entirely different wavelengths.

System Is Simple

In order to understand the receiver, it is necessary to outline what occurs at the transmitter, for actually the receiver is a reversal of the transmitting equipment. The entire secret of any of these systems is to convert a light ray into an electrical impulse, the variations of light giving variations of the electrical impulses in direct proportion to their brilliancy. This sounds more intricate than it actually is, for the system is simplicity itself. At the transmitter, an electric arc light is used as a source of light and a beam from this is focused to pencil-like proportions through small holes in a large metal disc.

Disc Broadcasts Pictures

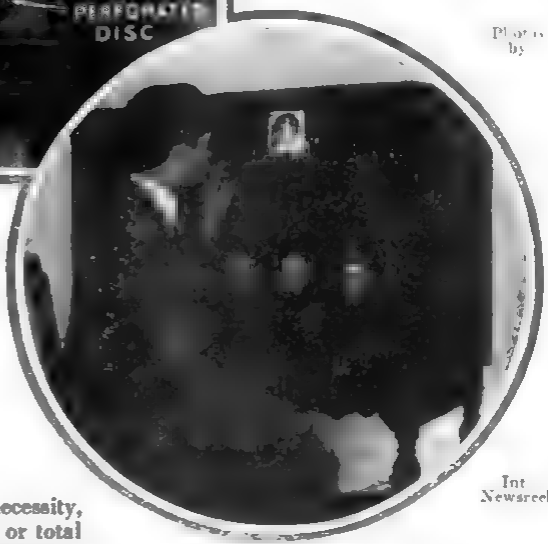
This disc revolves at a certain, predetermined number of revolutions per minute, in this case 450, and the pencil-like ray of light, after passing through the holes, travels crossways back and forth over the face of the subject being televised. The holes in the disc are arranged in a large spiral so that in one complete revolution of the disc, the ray of light covers the perpendicular distance of the subject.

This actually breaks the light ray up into a great number of small points of light, each of which reaches the subject's face slightly to one side of the previous one. When one complete revolution is made, the spiral is finished and the next one starts, but one revolution is sufficient to make one complete picture. Thus as the subject moves from side to side, we have a great number of small pictures made up of points of light.

Now comes the process of transforming these light rays into electrical impulses. The amount of light that is reflected from the

subject's face varies in direct proportion to the light and shade of the face. Thus where the eyes are, less light will be reflected because there is a certain amount of shadow, but where the cheeks are, the light will be reflected in its full intensity.

The subject sits facing a battery of three or more large bulbs, known as photo-electric cells and these have the facility of changing the reflected light rays into electrical currents in direct proportion to the amount of light reflected from the face. The cells are so arranged that only the light from the face is permitted to enter and of necessity, the subject must be seated in semi-, or total darkness in order to prevent other light from entering the photo-electric cells.



Photos by Int Newsreel

The working parts of a complete television receiver are shown above. The neon tube and perforated disk are the heart of the device. In the circle a televised subject is shown being tuned in on a receiver; the operator is adjusting the speed of the receiver's motor to correspond with the one at the broadcasting station so as to ensure faithful reproduction of the image.

Photo Cell Is Eye

Once transformed into electrical impulses, the system follows the regular broadcasting station procedure—through the line amplifiers and finally to the transmitter and thence out on the air. The photo-electric cells act on light waves just about the same as the microphone acts on sound waves and the results, in both cases, are fluctuating electrical impulses.

The problem is then to bring those impulses back to their original form and the receiver for this is so simple that almost anyone could make it. It comprises a disc, like the one at the transmitter, a motor for turning it, a means of regulating the speed of the motor (rheostat) and a neon lamp.

The disc may be made of any material that is stiff enough to hold its shape but brass or aluminum sheet will probably be found best. It is twenty-four inches in diameter and has 44 small holes cut in a spiral form, the two end holes being about 1 3-8 inches apart. By this it is meant that if we start the spiral at the top, when we make one revolution of the disc we will have 44 holes with the last hole 1 3-8 inches below the first one not directly below the first hole, because that would give us two exposures, but to one side at whatever spacing is necessary to in order to get the

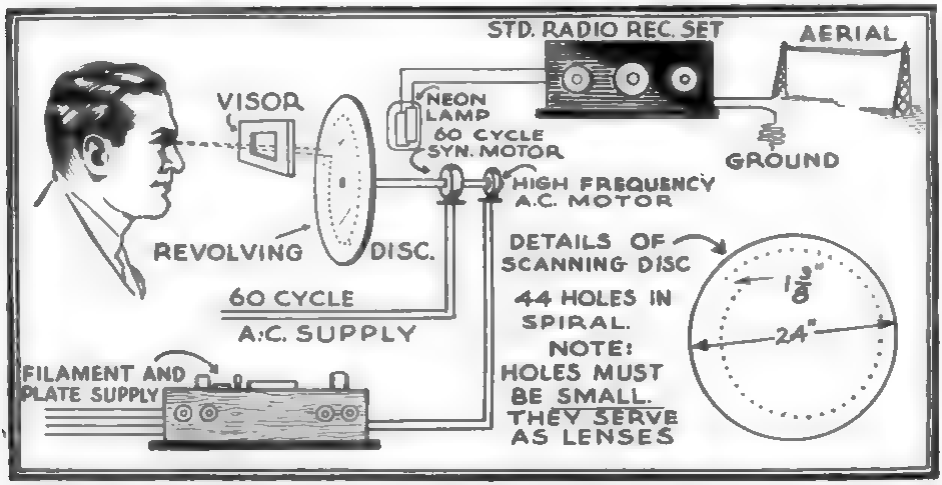
44 holes into the given space. The builder will have to work this spiral and the spacing out for himself. The holes are not quite a quarter inch in diameter and should be clean cut.

This disc may be driven by any kind of an electric motor, providing it does not turn up too fast. If it is driven from the 110 volt lighting main, a power rheostat should be used to cut the revolutions down to about 450 a minute. When in actual operation, this rheostat must be regulated carefully to the point where it will exactly coincide with the speed of the one at the transmitter. This is the entire secret of success for if the speed changes the picture will wander and go out entirely. A small battery motor may be used for the purpose, but it is not as good as the battery will slowly lose its power and the motor will slow down too much.

In back of the top of the disc, a small neon lamp is secured to a bracket in such a way that the holes in the disc will pass swiftly in front of the tube. This neon tube takes the place of the regular radio loud speaker and its wires are plugged into the ordinary receiving set. However, the best results will be obtained with a good resistance coupled amplifier and a suitable filter circuit at the output to prevent distortion. This neon tube has the facility of responding instantly to each change in current and an ordinary electric lamp will *not* do the trick under any circumstances.

On the side of the disc opposite to the neon lamp a visor is secured to a bracket in such a way that external light is screened off, thus making the picture clearer. The picture will be about 1 3-8 inches square and many experimenters are using a magnifying lens to make it about twice that size. The pinkish light from the neon lamp does not permit greater amplification of size as it is too weak but undoubtedly the day will come when an improved lamp will make much larger pictures possible. The pictures received are necessarily crude and "flickery" because the disc does not turn fast enough for unbroken pictures.

It is estimated that there are more than 2,000 television receivers within Greater New York, and Boston has a still larger number. Pictures from KDKA, WGY and a few other broadcast stations may be received on this equipment if the disc is turning at the proper speed, but these stations are not, as yet, on a regular schedule. It is probable that improvements will be made from time to time and within the next three years, television will become an established fact.



In the lower right hand corner are shown the essential dimensions of the scanning disc. There are forty-four small holes which act as lenses which are placed in a spiral so that the last one on the spiral is about 1⅜ inches below the top one. The circuit, shown above, is very simple. The neon lamp hooks to the loudspeaker plug on the ordinary radio and the impulses are rectified into pictures by the spinning disc.

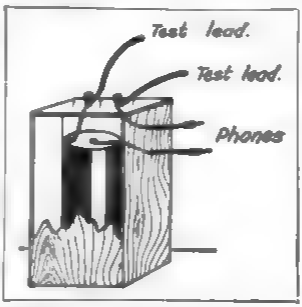
Conducted by CHARLES MAGEE ADAMS

Is your radio set giving you everything you have a right to expect from it—or does it "act up" and refuse to perform as it should? If your set is giving you trouble, write to Charles Magee Adams in care of this magazine; he will advise you how to solve your difficulties. Mr. Adams is nationally known as a radio expert. Each month in this department he gives pertinent pointers on how to get the most out of your radio.

How to Make a Simple Radio Test Box

WHILE constructing radios (and particularly when they do not "perk" as expected) the fan often has need of some device that will permit him to make tests of circuits for possible defects. The test box sketched in the drawing can be put together in a few minutes from materials found around the workshop, and though it does not take the place of precision instruments, it will save much time while shooting trouble.

The box may be anything of convenient size that comes to hand. The binding posts are placed and wired, the dry cell connected and the lid nailed down, after stuffing any waste space with paper to hold the dry cell solid. The test leads may be of bell wire, though lamp cord is better.



To use the tester, insert test leads in the indicated posts and the cord tips of a pair of radio headphones in the other two. When the free ends of the two test leads are touched together a click will be heard in the phones and when they are separated there will be another click. To test a circuit, it is then simply necessary to touch one test lead to each terminal of it. If the circuit is good there will be a click whenever contact is made or broken. If there is a break, or the circuit is open, there will be no click. In this way transformers, coils, wiring, etc., can be tested until the trouble is located.

In testing the windings of audio transformers and similar apparatus, it will be noted that there is only a faint click when contact is made and a much louder click when it is broken. This is due to the self-inductance of the windings and betrays no defect. Also, unlike other apparatus, the fact that no click can be got from a condenser indicates that it is in good condition. This is because direct current of low voltage will not flow through a condenser.

In testing wiring the tests should be made with the receiver's hookup as reference. This is necessary to guard against false con-

clusions. For example, a click can be secured by touching one test lead to almost any circuit of the receiver and the other to the ground. But this rarely means that there is a ground in the wiring, since virtually all parts of the hookup trace back to the ground, either directly or indirectly.

This same device will also be found useful in checking other electrical apparatus where the condition of circuits is to be determined.

A Simple Push-Pull Amplifier

THE trend in radio receivers this season is very much toward push-pull amplification for the last audio stage, and fans who wish to bring their sets up to date on this score will find that they can do so without difficulty by means of the unit shown in the accompanying diagram.

Besides two tubes, the parts required are a pair of push-pull transformers (one input and one output), two X type sockets, a half ampere filament ballast, hookup wire, and ten binding posts.

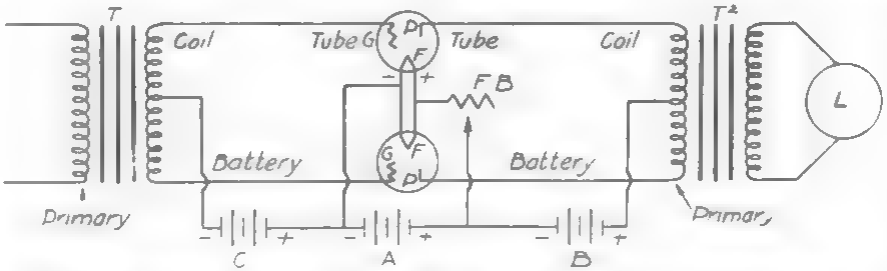
Making up the amplifier as a separate unit is recommended since this avoids the need of revamping the receiver on any large scale. If there is sufficient space in the power compartment the amplifier can simply be mounted on a baseboard of convenient size; or it may be housed in a small cabinet matching the receiver.

To install the unit when completed, remove the leads from the primary of the second stage audio transformer in the set, and solder them to a pair of wires leading to the primary of the input transformer. Then make battery and speaker connections as indicated. No power tube should be used in the receiver, since it now does no work; and the disconnected second audio transformer may be removed if desired for use elsewhere.

Two tubes of the same type should be used for the push-pull stage; that is, two 112A or two 171A. The correct C battery voltage is important for proper results, with the 112A, 9 volts for 135 volts B, and with the 171A, 40½ volts with 180 volts B.

The advantage of a push-pull amplifier over one of the usual type is that it permits greater volume without distortion. Instead of being placed on only one power tube, the receiver's load is divided between two, thus allowing both to operate efficiently.

Where B power is supplied by batteries, such an amplifier using two 112A tubes will give excellent results with less plate current than is consumed by a single 171A. An amplifier using two tubes of the latter type will, of course, give even better results, but a B eliminator is required. Also, this must be one large enough to carry the drain of the added tube without overloading, since both tubes consume full plate current.



In this diagram of a simple push-pull amplifier, T1 represents the input transformer and T2 is the output transformer. FB is the filament ballast and L the loudspeaker.

Combination of Horn and Cone Speakers

THE cone loudspeaker has come into such widespread popularity that the horn type which formerly occupied the spotlight has virtually been relegated to the discard. Yet thrifty fans who have kept their old horns stored away in some corner of basement or attic, thinking that some day they might have value as radio relics, can put them to interesting and profitable use in connection with their modern cone speakers.

The thing that doomed the horn, in spite of its impressive bell and graceful gooseneck, was its failure to reproduce the bass notes. At the lower end of the musical register its response was very meager, whereas the cone type responds well. Hence the cone came into the ascendancy, since the bass notes are vital for satisfactory reproduction.

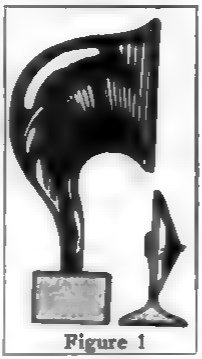


Figure 1

However, for absolute fidelity both the bass and treble must be reproduced with equal power, and the cone, though strong at the bass end, has been found to slight the high notes to a greater or less extent.

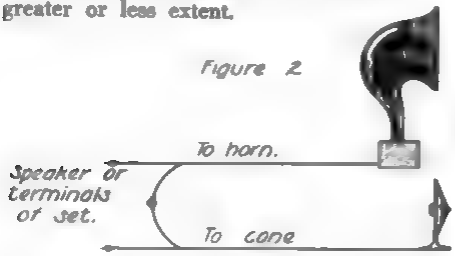


Figure 1 shows an effective and convenient way for using speakers of the two types with one receiver. In order to make the most of the combination the cone and horn should be placed together, else the effect will be simply of two contrasting versions of the same music and not a blended balancing of both.

Both Horns Work Together

The connections for this arrangement are shown in Figure 2. Contact between the tips of the two cords can be made with a spring clip or any other means that is handy. But if the receiver has a metal cabinet, as many now have, care must be exercised to keep this connection away from the metal of the cabinet which is usually grounded. A good plan is to wrap the joint snugly in heavy paper, dry cloth, or friction tape. Then there will be no risk of the live joint touching the metal and grounding the speaker circuit.

This arrangement permits both speakers to work together, the cone contributing the bass notes and the horn the treble, with a resulting quality that will be found superior to either when working alone.

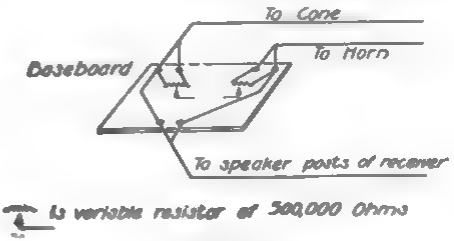


Figure 3

Fans who wish to add the slight complication will secure still more interesting results by use of the arrangement shown in Figure 3. The baseboard can only be of any convenient size, and the variable resistances should be of about 500,000 ohms. The sort used for volume control purposes will answer nicely.

From a study of the circuit it will be seen that each of the variable resistances is connected across one of the speakers. So if, for example, the one across the cone is set for its full resistance, the current will be deflected through the windings of the speaker, while if the setting is changed to a low resistance the current will take this shorter path and not flow through the speaker.

In this way both speakers can be placed in the circuit to full capacity by setting the resistances to full, or one cut in to full and the other cut out completely, with a wide number of variations between.

A TOY BOAT for 75c

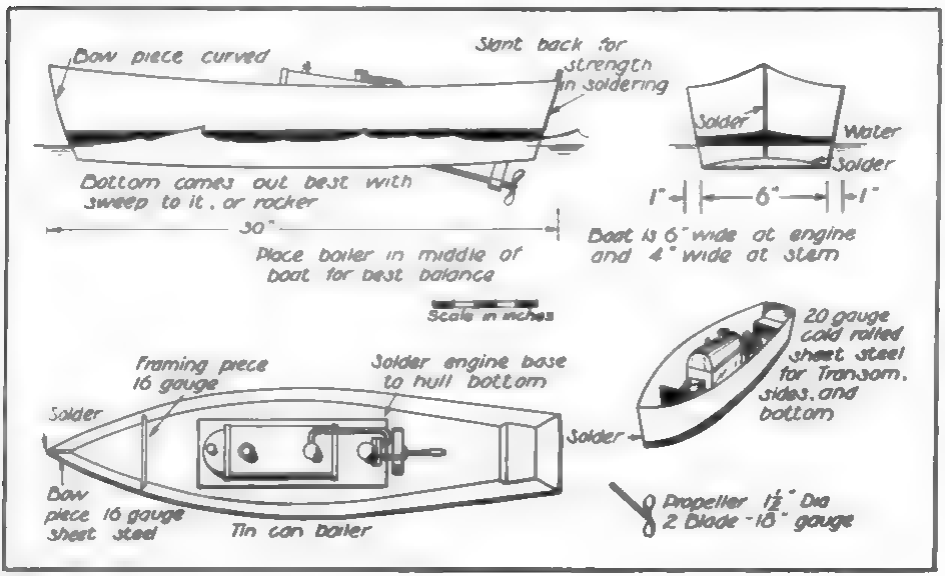
By T. S. ASGAARD

THIS toy boat can be made of sheet metal such as is found in any tinsmith shop. The sheets may be cut out to fit from cardboard patterns which are first pasted up to form the shape of the boat desired. Then the tin is cut to conform with the patterns thus obtained, and when soldered together the boat is complete, ready to install the machinery. The soldering can be done by any tinsmith, who will not charge more than 75 cents for the material and the labor. When done the boat is most serviceable and will run on most any type of power plant; clockwork, electricity or steam being easy to put into such a boat.

A few hints on building will not be amiss. The bow piece should be soldered on first. This goes onto the bottom piece, which has previously been cut to pattern. Then the transom is soldered on. The bow piece should be sweated in solidly, and the transom left tacked, for it is possible that the solder will have to be melted in some places to true the hull up after the seams along the bottom have been soldered.

The side pieces are tacked along the bow piece, and tacked at intervals of every few inches along the bottom seam. The bottom is all the while bent to conform with the sweep which has been cut into the side of the boat. Then when the side pieces have been tacked all along the bottom and have been tacked to the transom, the seam can be flooded with solder to make it tight, the tacking being melted the while so that the hull will take true shape.

The bulkhead will require some fussing, for the exact slant of the flange will have to be found by trial and experiment. It is sweated in thoroughly. Then whatever engine you have decided on is installed and the boat is done.



A Modern Mechanics Model BOAT CONTEST

This handsome trophy cup with the winner's name engraved on it and $25 is the first prize in the Model Boat Contest.

A HANDSOME engraved trophy cup and a cash prize will go to the amateur boat designer whose model power boat wins the second Modern Mechanics Model Building contest. Study the rules below.

2. Awards will be made on the basis of the workmanship, ingenuity of design, and general running qualities which the model exhibits in the water. It must be understood that this is not necessarily a contest for *elaborate* or *complicated* models.

PRIZES FOR BOAT BUILDERS

First Prize, Trophy Cup and $25
Second Prize $10
Third, Fourth, Fifth Prizes, ea. $5

WEIGH UP! Here's the second Modern Mechanics Model Contest! You young Herreshoffs have let the potential Lindberghs have their try at the model airplane contest announced last month, and now it's your turn to show what you can do in the way of constructing fascinating models that really run.

The Editors have put up another beautiful silver trophy together with cash prizes for the amateur designers whose models win the second of Modern Mechanics series of Model Building Contests.

Each month Modern Mechanics Magazine will sponsor a model building contest, the subject to be announced in time for readers in all parts of the country to compete. The rules for the second contest, on model power boats, are given herewith:

1. The Model Power Boat Contest models must be built by the contestant himself. The power plant may be of the manufactured kind. The models must be capable of running under their own power. There is no other restriction as to size or type.

3. Decision of the Judges, Weston Farmer, naval architect, and Capt. Bud Wing, boating expert, will be absolute and final.

4. In case of a tie a duplicate cup and duplicate prizes will be awarded tying contestants.

There is still time to get in on the Model Airplane Contest if you send your model in before Dec. 1, 1928. Full details were printed in the November issue.

5. The right is reserved to publish photographs and working drawings of the winning model or models, in Modern Mechanics Magazine.

6. Models must be securely wrapped and sent express prepaid, to the Editor of the Model Power Boat Contest, Modern Mechanics Magazine, Robbinsdale, Minn. This magazine assumes no liability for possible damage to models incurred in transit, but will observe every precaution in handling submitted models. Entries received will be returned express collect within thirty days from the close of the contest. Full return address must be furnished together with a note agreeing to pay return charges upon presentation of the package by the express company.

7. It is not necessary to be a subscriber to Modern Mechanics Magazine in order to compete. Copies of this magazine are available at schools and public libraries.

8. The contest is open to anyone except employees of Fawcett Publications, Inc., and their families.

9. Contest closes January 1st, 1929.

The Judges will have the models tested in an indoor tank or an open sheltered expanse of water, according to weather conditions, and the size and power of the model.

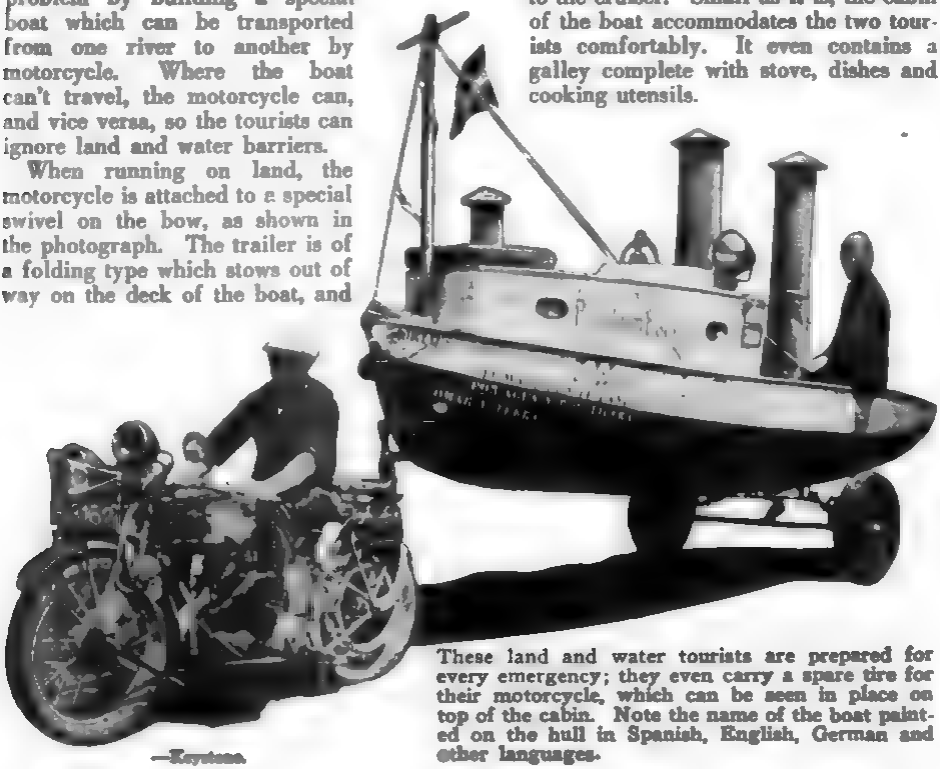
Announcement of the winners of the trophy will be made as soon as possible after the close of the contest.

Touring Europe in Boat and Motorcycle

TWO ingenious young Spaniards who wanted to tour Europe thoroughly yet not expensively found the answer to their problem by building a special boat which can be transported from one river to another by motorcycle. Where the boat can't travel, the motorcycle can, and vice versa, so the tourists can ignore land and water barriers.

When running on land, the motorcycle is attached to a special swivel on the bow, as shown in the photograph. The trailer is of a folding type which stows out of way on the deck of the boat, and the motorcycle itself is lashed to the top of the cabin when not in use.

"On Water and Land," is the name given to the cruiser. Small as it is, the cabin of the boat accommodates the two tourists comfortably. It even contains a galley complete with stove, dishes and cooking utensils.



These land and water tourists are prepared for every emergency; they even carry a spare tire for their motorcycle, which can be seen in place on top of the cabin. Note the name of the boat painted on the hull in Spanish, English, German and other languages.

—Keystone.

Motor Coach Pullmans Last Word in Comfort

TWELVE passengers are accommodated in the Pullman berths of the luxurious motor coach shown above, recently put into service between London and points in Scotland. The new motor bus is a "double decker," containing both upper and lower berths, which during the day are made up into comfortable cushioned chairs. Hangings in front of the berths provide absolute privacy. The coach is equipped with a lavatory, special compartments for passengers' baggage, drawers and hangers for personal belongings—in fact, nothing has been overlooked which could in any way add to the comfort of travelers.

The driver's compartment is in the front, and it will be noticed by the photograph that the steering wheel and controls are on the right side of the engine in conformity with English custom. An observation room is provided above and in back of the engine hood for the use of passengers. An aisle passes directly through the center of the coach and the berths are arranged on either side, just as in a railway car.

In the past the motor coach has not been a serious competitor of the railroads on long passenger hauls, but with the development of these new sleepers it is expected that this cheaper form of transportation will come into increasing favor.

A PORTION of the upper photo has been cut away to show the arrangement of the berths. Each of the double windows shown in the picture opens on an individual compartment. The other picture shows the aisle and the interior arrangement of the car. Note the sliding curtains to insure privacy.

Engine Model Wins Prize for 80-Year Old Maker

AN ELABORATELY worked out model of a horizontal steam engine, on which he has been working for several years, recently won one of the first prizes in the 1928 London Model Engineer Exhibition for its 80-year old designer, G. F. G. Des Vignes. The model maker and his prize winning engine are shown in the photograph below. Another model of a hydraulic pumping engine also won a prize in the same exhibition.

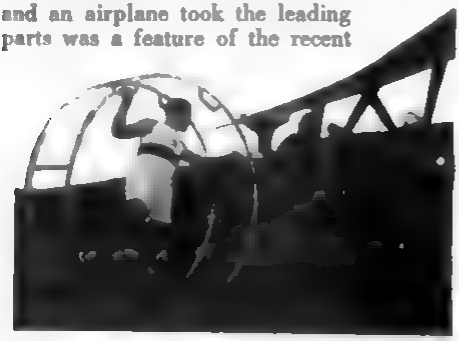
Mr. Des Vignes recommends model making as the most fascinating of hobbies. He has a complete machine shop in which he does all his pattern making and machining.

For many years Mr. Des Vignes was an authority on high-speed torpedo-boat and river launch design. His famous steam launch *Hibernia*, a 29-mile per hour boat which at the time of its construction was the fastest launch ever built, was used for years in coaching and umpiring the annual boat race between the Universities of Cambridge and Oxford.

The 80-year-old designer of this steam engine is shown tightening a nut on his prize - winning model.

Man-Wheel and Airplane in Novel Relay Race

AN UNUSUAL relay race in which a runner, an athlete in a Rhoen wheel, and an airplane took the leading parts was a feature of the recent Flying Meet in Berlin. The photograph shows one of the gymnasts passing the relay flag on to the air pilot who is waiting to give his ship the gun. Six teams competed in the novel race.



BRITISH BUILD TINY CAR

A 9-horsepower motor car with a four cylinder motor capable of making 50 to 55 miles an hour has been brought out in England to meet the demand for a cheap car of low upkeep cost and small horsepower. Forty-five to fifty miles per gallon of gasoline is claimed for the new car.

The New President's HANDWRITING

By M. N. BUNKER, Noted Graphologist

HERBERT HOOVER

HERBERT HOOVER is a builder. He thinks constructively. He is the type of man, that as a boy would make a box absolutely square. He is not merely an engineer because he chose that profession,

but because he is by all his mental processes the type that constructs. His small "r's" and his joinings at the base of the "b" are square. Such lines predominate and this is an unmistakable sign of the constructive nature. He does not talk about what he has done, preferring to let his accomplishments speak. This is shown by the decided loops with which he closes his small "o's."

He is kindly, sympathetic, and generous. This is shown by the forward slant of his writing, and by the swing he gives to the finish of the last letter.

He ties the "t" in Herbert, which is a strong indication that he will finish any job he undertakes. He "ties it off" just as a rug weaver finishes a rug.

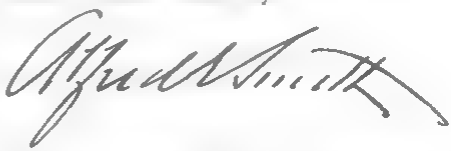
This is emphasized by the difference in size between the capital and small letters, the capitals indicating self-reliance, and the small letters the concentration with which he will go about the accomplishment of anything he may have to do.

ALFRED E. SMITH

ALFRED E. SMITH sticks to anything he undertakes to accomplish. His tenacity will not permit him to give up. Those very decided hooks with which he finishes the "h" in Smith, and the cross-bar of his "t" both indicate very unusual development of this trait.

He is the type of man that is very enthusiastic about anything in which he is interested. His long sweeping stroke with which he crosses his "t" is unmistakable evidence of this trait. His final stroke in finishing the "h" in Smith shows prompt and generous response to an emotional appeal, while the spacing of his letters in the signature as a whole show conservativeness in thought and action, except when his emotions are stirred. It is then that he gives lavishly.

He is gracious, a good "mixer." Sharp pointed letters prove this; also he does not close his small "d" and the capital "A," which indicates sociability.



There is decided disconnection between the strokes in almost every letter. This is the sign of strong intuition, and of artistic inclinations in one field or another. If he had not chosen the field of politics, Alfred E. Smith might have won fame on the speaking stage.

Get Football Thrills in Slow Motion

Mary Eaton, stage star, using Victor Cine camera.

COMPARED with other thrills, few can be found in amateur movie making to equal the film of a spectacular forward pass or a flying tackle shown in slow motion. What is a blur of action on the field becomes an easily distinguished series of vivid pictures when thrown on the home screen.

Several manufacturers of amateur motion picture cameras have perfected the use of slow motion photography, including the new Bell and Howell Filmo and the Victor Cine-Camera.

The Victor model has an adjustable speed that enables the camera man to take normal, ultra speed, half speed and stop action films.

Slow motion photography, to be successful, requires a bright day, as the film is run through the camera at twice or three times the normal speed. Football days are made for this work with their tangy, clear air, and bright sunlight.

But slow motion has so many possibilities that it would be unfair merely to emphasize the place it has in photographing fast action games. Many amateurs are going in for unusual effects in settings, requiring small models for this work. A pirate picture, for instance, is being made with a model of an old Spanish galleon sailing on a pond. If taken in slow motion, the ship will heave and roll just like a normal sized craft, whereas taken in normal speeds the model will bob up and down on the waves and the illusion is destroyed.

The effectiveness of a football film can be greatly improved by combining far shots with close ups. Obviously, to obtain a close up one cannot dash into the field. Here, again, a clear day is necessary. Telephoto lenses may be attached to most makes of movie cameras. A tripod should be used when employing this extra lens. When shown on the home screen, these action pictures are very effective, and to a spectator who does not know how they were obtained it appears that the photographer had his camera right on the field.

Edit Your Own Films for Best Results

AFTER you've taken a couple of hundred feet of home movies, don't be content to run the film through the projector just as it was taken. Editing is fully as important as the photography—and no more difficult.

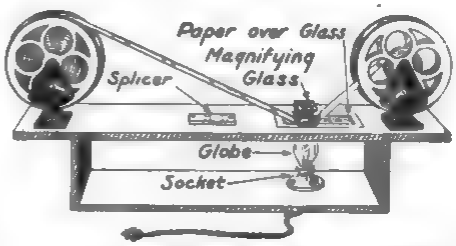
Suppose you have taken several spools of your family, from baby to grandparents. Scenes follow in hit-or-miss order, showing whatever views happened to be convenient to shoot at the time. After running the film through the projector, stop for a moment and consider with a cold, professional eye, just what are the good shots, and nerving yourself to discard the bad. Then mentally review the sequence of the film. Perhaps you "shot" some of the family on the sidewalk by the car, just arriving, yet this appears toward the end of the reel. Obviously, the place for it is at the start. And then, maybe, there was one spot that everyone liked—baby waving goodbye. A peach of an ending!

All right, you're ready to edit. The first essential is proper equipment. With the projector is supplied a little splicing device with instructions as to its use, and containing a supply of cement. But you would have to buy a re-wind outfit. A number are on the market, for a few dollars up to many. Why not make your own?

Shown here is a simple editing outfit which would cost as much as twenty-five dollars to duplicate on the market. Take a six foot board, six inch width, and saw off about three feet for the top board. Toward one end make an opening for film inspection by under lighting. Drill four holes through the board and with a small scroll saw (Woolworth's 5 & 10c) saw the square aperture. A square of glass is set over it, and its outline penciled on the board. A chisel quickly tools out a frame for the glass, so it can be sunk in flush with the board top. Cover the glass with white paper to make it opaque.

Now make the bottom board, and sides, as shown on the diagram. Any dimensions will do. Stain the boards some suitable color.

Before completing the open box by attaching the top board to the side uprights, lay the top board in place and mark the spot for the lamp socket. This is also a dime store purchase, of standard porcelain base style. Connect it with a lamp cord and plug.



You can easily make this cutting outfit in your basement workshop, at a saving of ten to fifteen dollars and edit your films yourself.

The splicing device is screwed down and the next step to complete the outfit is a pair of brackets for the spools of film. These will constitute your main outlay, and will cost five dollars or more. One or both of the brackets may be geared and equipped with a handle for winding.

With the brackets screwed in place you are ready to edit. Place the empty film on the left hand bracket and run out a few feet. When you come to a place where cutting is to be made, inspect the film over the glass and choose the exact frame. Then place the film over the splicer and lop it off. Hang the film on a rack—don't let it touch the floor. Films become magnetized and will pick up the dust. After your film is cut—perhaps in a dozen places—start splicing in the manner explained in the directions supplied with each camera, and wind the film as spliced onto the right hand bracket.

For closer inspection of films, a magnifying glass, as shown in the diagram, will be a handy addition. After running a film through the projector a few times, it should be inspected for broken film sprockets and the magnifying glass will assist you here. The outfit will also serve to clean your films, by folding a piece of plush over the magnifying glass, wetting it with cleaning fluid sold for this purpose, and running the film slowly through this purpose, and running the film slowly through the cloth. Do it slowly—don't wind the film up while it is damp.

The glass will be indispensable if you plan

to insert titles, particularly if these are talking titles. The title should be inserted at just the right frame if the film shows the actor speaking his lines. Experimenting will show you the knack of this.

If you are editing a family film, why not get a lead title such as "Our Family" with the date below? The cost will be slight in comparison to the improvement in your edited film.

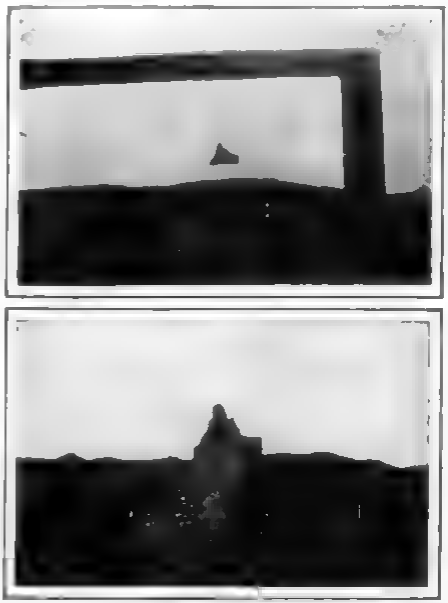
Building Castles in the Air

IF YOU'RE an ambitious camera man, you'll wish you had some castles in your back yard for some really pretentious sets. It can be done by building them in the air!

Make a drawing of a castle that suits your imagination, and paste it on a piece of glass. Set the glass up about five feet in front of the camera, so that the castle appears, through the finder, to be built on the top of a hill. Beyond the glass the actors can go through their parts and an excellent effect obtained.

The snapshots at the right were taken with a box camera by the location man for a company of amateur movie actors. They wanted a castle, and told the location man to find one. He did. The castle was drawn up and pasted on the glass door of his car. When he found a suitable hilltop he opened the door and snapped the shot.

The top picture shows what happens with an inaccurate camera finder. The castle indeed was of the air variety! He corrected this fault, however, and his next shot was in proper line. The movie makers then set up a glass, and, profiting by his mistake, gave the castle a base so that it would be sure to show resting on solid ground. Care must be taken to prevent a reflection showing on the glass, and the castle must not be too close to the camera or it will be out of focus. Using a tripod will get the best results on this camera trick.



In the top picture the castle, painted and pasted on glass, is floating in the air, due to faulty camera finder. After experimenting, the castle was properly placed. These rough snaps were made for an amateur movie club by their location man.

James Cruze, movie director, takes a photo of Marie Prevost with his Pathex movie camera.

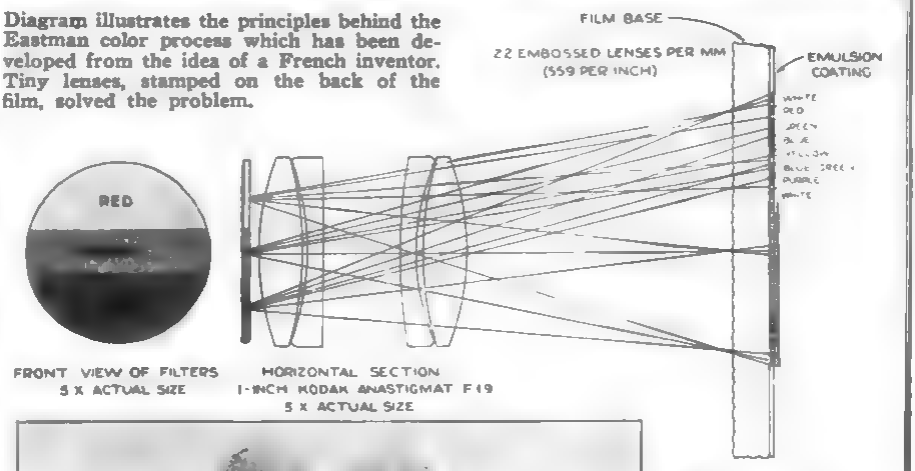
The SECRET of MOVIES IN COLOR

By DR. C. E. K. MEES
Director of Eastman Research Laboratories

A PHOTOGRAPHER using a standard Cine Kodak fitted with an f-1.9 lens only has to insert a color filter into the lens and thread the Kodacolor film in the camera. After the film has been exposed, it is sent to us for processing and comes back to the photographer as a roll of black and white film which can be projected in an ordinary projector and will give a black and white picture on the screen. But if the projector is fitted with a special color filter like that which is used in the camera, then a colored picture will be obtained.

This color filter is composed of three separate areas—red, green, and blue—and it slips into the lens in the place of the ordinary hood. But the secret of the Kodacolor process is in the film. The film surface is embossed by running it through steel rollers with tiny cylindrical lenses composed of the film base material and extending lengthwise of the film. The lenses on the film are about seven times narrower than the dots making up the illustrations in a newspaper, and they are therefore invisible except under a microscope. They cover

Diagram illustrates the principles behind the Eastman color process which has been developed from the idea of a French inventor. Tiny lenses, stamped on the back of the film, solved the problem.



George Eastman shows Thomas Edison, movie inventor, the Cine Kodak and filter used to shoot the 16 mm. film in natural colors.

Embossed Lenses Make Color Movies Possible

completely the surface of the side of the film opposite from the sensitive emulsion. That surface faces the camera lens, and the emulsion is away from the lens.

When the trigger of the camera is pressed, light reflected from the subject passes selectively through the three-color filter, on through the camera lens, and thence through the tiny embossed lenses on the film to the sensitive emulsion coating on the opposite side, where it is recorded. The function of the lenses embossed on the film is to guide the rays of light falling upon each tiny area and lay them on the sensitive emulsion as three distinct impressions corresponding to the three filter areas so that the three colors covering the lens are imaged behind each tiny cylindrical lens as three parallel vertical strips, because the tiny cylindrical lenses are parallel to the stripes of color on the filter. Thus the width of each of the minute areas of emulsion is subdivided into three parts related to the three filter areas and affected by light that is able to pass through the different colors. The sum of these invisibly small affected areas of film constitutes the whole photographic image.

A red ray from an object in front of the camera, for instance, reaches the sensitive material of the film at a spot related to the red area of the filter. The "Reversal Process" turns this affected spot into a transparent area, leaving opaque the adjoining unaffected areas related to the green and blue segments of the filter.

So, also, with the green and blue and with combinations of colors. The sum of the points on the scene containing red makes a photograph from red light on the emulsion areas related to the red filter area, the sum of the blue also makes a separate photograph, and similarly with the green.

System of Projection

In order to project the pictures, the developed film is put in the projector, which contains exactly the same optical system reversed. Behind the film is the condenser and the source of light. The color filter consists of the same three primary colors —red, green, and blue. The reverse of the fact that white light divides up into the colors of the spectrum is that light coming evenly out from the three colors of the filter on a projector and superimposed on a screen appears white.

But cover up the green and blue segments of the filter and the screen will turn red. Cover up the red and blue and the result will be green.

With the red and green areas both left for the light to shine through, we get yellow. White minus red gives blue-green. White minus green gives magenta. Varying the areas of each color through which the light may shine will give infinite shadings between these colors.

When we have a picture on the film, the opaque areas of the film cover up, in effect, certain of the filter areas; they prevent the light from going through where it is not needed, by cutting off, at the film, rays which would otherwise pass out through the embossed lenses, through the projection lens, and through the filter area in question to the screen.

For any point on the scene, the only colors which are permitted to be projected are those which, on the screen, blend into the corresponding original colors of the scene photographed. The pattern of these rays from all the cylindrical lenses on each frame projects a picture on the screen, with each ray contributing its speck of light to the color or blend of colors at one point.

The film itself is not colored. The colors of the subject are reproduced merely by the transparency of the film, or by black metallic silver deposited in various degrees of opacity, so as to permit light to shine through one of the three areas of the filter as directed by the tiny film lenses.

RUNNING FILM BACKWARDS PROVIDES HUMOROUS EFFECTS

A NEW projector perfected by the Eastman Kodak company provides some opportunity for novel effects. By pressing a lever from forward to reverse, the film immediately starts running the other way. A diver can be shown rising from the water and landing on a springboard, and other humorous effects obtained

Making Roses Grow on the Silver Screen

Above is shown the time-lapse camera invented by Howard Greene which takes rapid-motion pictures showing growing plants.

THE amateur movie maker blessed with a little mechanical ingenuity can make his camera into a "time-lapse" machine which will enable him to take action pictures showing rose buds opening into flowers, dandelions growing up and going to seed, and other natural phenomena normally occurring over a long stretch of time.

This is made possible by exposing the film once every half hour or so. When the film is projected at the end of a week or month the growth of the plant is plainly shown on the screen. The picture above shows the time-lapse camera of Howard Greene, who is a prominent experimenter in this field.

The mechanism of Mr. Greene's device is not complicated, consisting of clock-work connected with an electric motor which opens the camera lens at predetermined intervals. Any amateur with a flair for experimenting can adapt such apparatus to his own machine. In case the movie maker does not wish to go to these lengths, interesting pictures can be obtained by exposing the film by hand every hour or so, using fast growing subjects such as the dandelion. A dandelion photographed by Mr. Greene grew out of the camera's range in 12 hours.

Remarkable pictures of sprouting seeds have been obtained by Mr. Greene. In four days clover seed will produce sprouts 50 times as long as the seeds from which they developed. Such motion pictures are not only interesting to produce, but are educational in giving one a better appreciation of the processes of nature.

TABLE LAMPS *Easily Made from* OLD BOTTLES

BY CHARLES ALMA BYERS

At last, a use for discarded bottles! Handsome table lamps can be made from them by following directions given in this article. The lamps are easy to make, cost very little, and are useful and ornamental additions to the household furniture.

THE making of table lamps from old bottles of suitable sizes and styles has become a popular fad, and one that holds some interesting possibilities. Indeed, some of the lamps made are exceptionally attractive, and make worthy additions to the furnishings of almost any home. Some, however, follow more or less novel or grotesque lines, and are in their proper environment only in a den or in some room furnished with odds and ends.

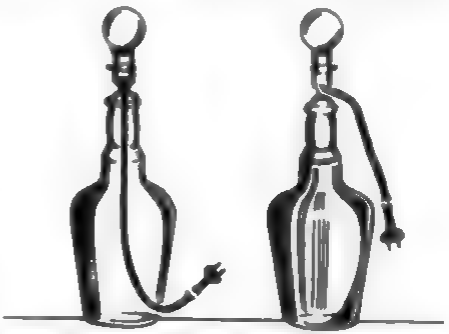
This photo shows bottle lamps in several stages of completion. Note how the bottle shapes blend gracefully with the lines of the

Bottles for the purpose must, of course, be rather large. At least they should be sufficiently heavy at the base to keep them from being easily tipped over. Water bottles, decanters, Mexican ollas, etc., especially if of some unusual or distinctive style, are particularly suitable. Many of the old-time liquor bottles of odd or fantastic shape are also being used. In fact the latter, if having the appearance of great antiquity, of being hand-made, or otherwise being out of the ordinary, find exceptional favor for the purpose.

Even flower vases—usually those with large bases and comparatively small tops, and perhaps of exquisite coloring—are likewise frequently employed.

The conversion of these bottles into table lamps is done very simply and inexpensively. It is only necessary to equip them with the necessary electric-light wiring and fixtures and then add some appropriate lampshade. The wiring is usually turned over to some electric-fixture store, and, aside from the cost of material used, should entail no very great expenditure. However, the wiring may be done by oneself. Holes may be bored through glass by using the haft end of a rat-tail file, twisting it around until the hole is worked through.

In the ordinary equipment, a light-globe socket is extended upward from the mouth of the bottle after the fashion of a cork or stopper, and dropped loosely down the outside of the bottle will be the usual cord



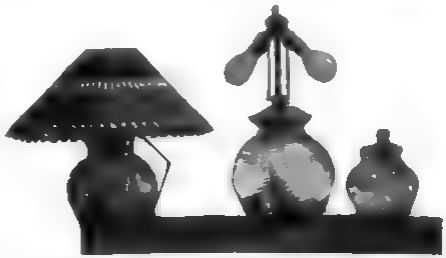
Wiring is easily done by boring holes through the glass, following the simple method explained in this article.

Turning Old Bottles Into Household Ornaments

and plug for tapping the wall socket. The globe socket extending from the mouth of the bottle, if of a size to fit snugly, may be firmly cemented into place with sealing-wax. If too large or small to fit into the bottle mouth, it will be necessary to make a special stopper for the bottle with a larger or smaller hole bored in the top for receiving the butt end of the globe socket. The cord ordinarily exits from the socket at the butt end, but bending it back along the outside before cementing the socket in place will enable the cord's being kept on the outside of the bottle.

Naturally, the foregoing presents only a basis for the work. Details of the operation will have to be worked out according to the particular problem confronted. Very large mouthed bottles, such as ollas, will require something special in the way of stopper or covering for receiving the globe-socket equipment. Again, very squat bottles or vases may need some sort of standard to raise the globe to greater height. Also, in some instances, it may be desirable to have equipment that will provide for two light globes, instead of a single one. The illustrations show some of these variations.

The lamp-shade, in the simpler arrangements, is usually made so that it may be directly clamped on to the light globe, with wire clamps, or will be provided with a small metal band for fitting about the socket, with wires for raising the shade to additional height.



Double sockets can be attached to bottle lamps which have sufficiently large bases.

If, because of the comparative smallness of the bottle or vase, the lamp seems top heavy, the bottle may be filled with sand or some other substance to give it weight and steadiness. Bottles are often filled with colored water to give them added attractiveness. By so doing, they may be made to contribute effectively to the room's color scheme.

How to Draw a Perfect Circle Without a Compass

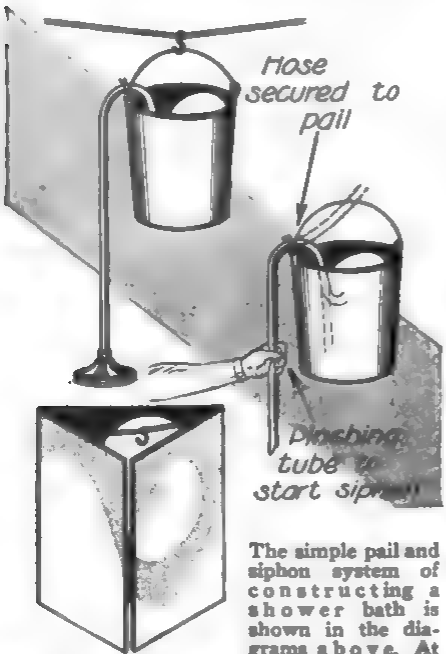
DRAWING large circles with a piece of string or thread attached to the pencil is very often necessary when no other means of doing the job is available. It is not a hard matter to tie the string around a nail or pin for the center or pivot end of the string, but as the string usually must be tied an inch or so above the pencil point around the wood, the circles drawn are usually inaccurate.

Take a small two hole button as shown, knotting one end of the string to hold it in one hole, placing the point of the pencil in the other. It is then very easy to draw circles accurately and smoothly. The circumference curves will join perfectly at the starting point. The circle will be true, and can be easily drawn over the same line again if necessary without getting wavy or double lines.

Conducted by MRS. C. M. SULLIVAN

AS EDITOR of this department of Modern Mechanics Magazine, Mrs. Sullivan is constantly on the watch for practical ideas which will help to lighten the labor of the housewife. Her years of experience as director of the Household Service division of a large New York department store have qualified her to pass upon the merits of the steady stream of inventions brought out to lighten household duties.

How to Make a Portable Shower Bath



The simple pail and siphon system of constructing a shower bath is shown in the diagrams above. At the left below is shown a typical shelter arrangement above which the siphon is suspended.

AN EFFICIENT shower bath can easily be constructed from an old pail and a length of rubber hose with a perforated needle-spray attachment at one end.

A tarpaulin draped over a frame, as shown in the diagram, or some similar device is used to insure privacy. A few feet of clothes line is stretched across the outdoor bath and a piece of wire is bent in an S-shaped hook to support the water pail, which is hung above the bather.

The well-known siphon principle is used to furnish "power" for the bath. One end of the hose is inserted in the water pail and lifted up several times until the tube is filled with water, the liquid being held in the hose by pinching it with the fingers. When the pressure is released, the water will spray through the hose until the pail is emptied. It is important that the spraying end of the hose be held below the level of the bottom of the pail; otherwise the siphon will not work.

On camping trips an even simpler bathing device can be made from a pail on which is fitted a tight lid, perforated so that when it is held over the bather the water showers through it.

Folding Bed Gives Extra Room in Apartment

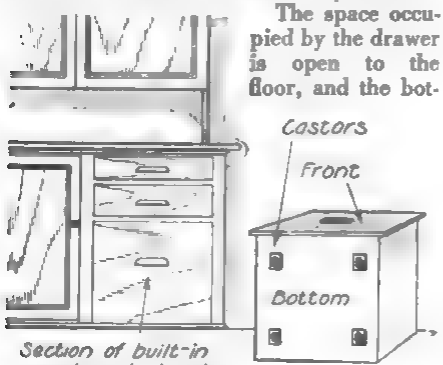
ARCHITECTS are constantly on the lookout for new ways of increasing the room space at the disposal of the housewife. A new adaptation of the old folding-bed idea is illustrated in the photograph at the right. The closet in which the bed is kept when not in use is fitted with doors containing mirrors, which serve the double purpose of hiding the bed and of giving an effect of increased depth to the room. By simply unfolding the bed the room is changed from an attractive parlor into a bedroom.

—Keystone.

SUBSTITUTE FOR FLOUR BIN

THE old-fashioned family flour bin is going out of style, yet some place for flour is needed in every kitchen. In the newer bungalows a lower drawer in the built-in cupboard is finished for the purpose.

This drawer is eighteen inches square by twelve inches deep and was made with a partition dividing it into two compartments. These were then lined with zinc by a tinner. The space occupied by the drawer is open to the floor, and the bottom of the drawer itself is equipped with four ball-bearing casters, making it easy to move about. The front comes down flush with the floor, while the top and sides extend out half an inch, making the whole dust proof.

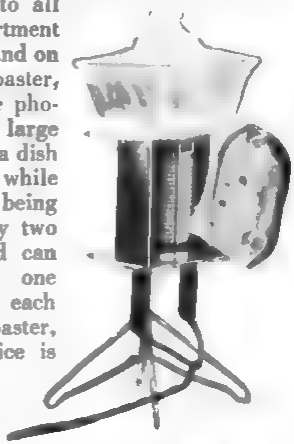


Section of built-in cupboard showing drawer for flour and sugar.

This receptacle holds twenty-five pounds each of flour and sugar, which is as much as is usually bought at one time by the ordinary town or city family of today.

MIDGET TOASTER IS ALSO FOOD WARMER

A TINY toaster which also serves as a food-warmer has recently been invented as a boon to all one-room apartment dwellers. A stand on the top of the toaster, as shown in the photograph, is large enough to hold a dish and keep it hot while breakfast is being prepared. Only two pieces of bread can be toasted at one time, one on each side of the toaster, but as the device is designed as a "one-man" affair this is not considered an objectionable feature. The toaster can be plugged into the regular lighting circuit.



—Wide World Photo.

How to Take PICTURES Without a CAMERA LENS

By WALTER E. BURTON

INTERESTING wide-angle photographs can be obtained by substituting a pin-hole for the ordinary camera lens. Mr. Burton explains in this article how this little-known stunt is accomplished.

HENRY, who had just returned from the drug store, threw an envelope on the table, disgustedly. It was one of those envelopes which carry surprise and not a little disappointment to so many amateur photographers.

This photo, taken with a pin-hole lens, shows the wide angle of view obtained. The camera was placed at the pavement edge, yet curbing and man-hole cover three feet distant are included.

"What's wrong?" asked his wife, Dorothy.

"Oh, just another set of bum pictures of the house," he replied. "That makes the third time I have tried to get a good picture of the front yard and front of the house, and every time there has been something wrong. Either the roof or one side is cut off, and the house usually looks as if it were falling over backwards."

"Can't you get back farther, so as to include everything?"

"That's just it. Those trees in front won't let me."

"Why don't you go over and see Jack?" Dorothy asked. "He is a photographer and ought to be able to help you."

That evening Henry carried his troubles and his various unsuccessful pictures to Jack Bender's home. After he had explained his troubles, he showed the bunch of "bum prints" to Jack.

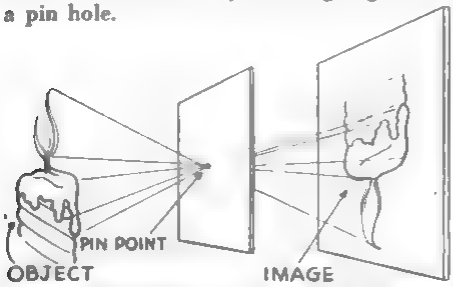
"Too close to the subject," was Jack's decision, after he had glanced over the pictures.

"But I can't get back any more," Henry complained. "You know my house is pretty close to the sidewalk, and there are too many trees in front for me to get across the street."

"Well, I don't suppose you want to cut the trees down, so we will have to figure out some other way," Jack replied. "First of all, you can take the lens out of this camera, for you won't need it."

"Take the lens out! Then how can I make a picture?" Henry exclaimed.

"That is where the fun begins. You won't need a lens because you are going to use a pin hole.

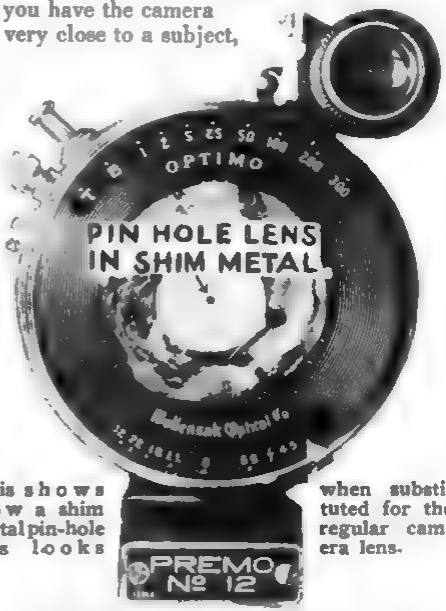


The pin-hole shuts out all but a small bundle of light rays from each point of the object, acting like a lens as shown by the above diagram.

"One remarkable thing about a pin-hole lens is that it can be used very close to the film or plate, so that an extremely wide angle of view is obtained," Jack explained. "To make a pin hole, you can simply take a piece of black paper and punch a tiny hole in it with a needle. This paper 'lens' can be mounted over a hole in a stiff disc of cardboard which is in turn inserted in the camera lens opening, from which the regular lens has been removed. Another way of making a pin hole is to punch a tiny hole in a thin piece of shim metal, allowing the needle point to go barely through. Then smooth down the little bump on a fine whetstone, and again insert the needle, twirling it to make the hole round. The hole should not be too small or too large or else a blurred image will be obtained."

"How will I know when the picture is in focus?" asked Henry.

"A pin hole lens is always in focus," Jack replied. "By moving the pin hole near the film, you increase the area included in the picture and decrease the size of objects. If you have the camera very close to a subject,



This shows how a shim metal pin-hole lens looks when substituted for the regular camera lens.

you must have the film close to the pin hole, in order to include all of the object. Usually when the pin hole is at the same distance from the film as the original lens, the size of the image will be about the same."

"How about the exposure?" Henry inquired.

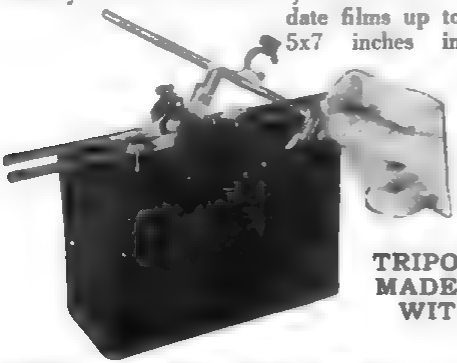
"You will have to give a longer time than that required for an ordinary lens," Jack replied. "In average daylight, the exposure ought to be about one minute for landscapes, for an average size pin hole. The slowness of a pin hole lens is its greatest disadvantage, but you will find it very interesting to experiment with."

Excellent still-life photos can be obtained with pin-hole lenses. This one was made by artificial light, with a 4-minute exposure.

TRICKS and short cuts that help to make the sport of the amateur photographer even more fascinating will be printed in this department each month. Anything that will help you to take better pictures, or less expensive pictures, or more unusual pictures, comes within the province of The Dark Room. Address Modern Mechanics Magazine, Robbinsdale, Minn., if you have any questions that puzzle you concerning the efficient operation of your camera.

Discarded Battery Jars Make Developing Tanks

DISCARDED rubber storage battery jars make excellent chemical tanks for the developing of photographic cut films or pack films. Metal hangers, obtainable at any photographic supply store, are used to suspend the films in the solution. The jars are usually of such size that they will accommodate films up to 5x7 inches in size. For exclusive development of smaller films, the jar may be reduced in size by cutting a section from the top, making possible the using of a smaller amount of solution.



Usually three battery jars, costing but a few cents each, will be required—one for the developer, one for the water rinsing bath or hardening solution, and the third for the fixing bath. A 20-minute time developer that will keep for several weeks will be found best. A wooden float should be placed on the surface of the developer when it is not in use, so that oxygen from the air will not cause the solution to spoil.

TRIPOD POINTS MADE NON-SKID WITH CORKS

THE amateur photographer often has to set tripod points on cement or other smooth surfaces where they easily slip and skid. Dig the thin cork bits out of several pop bottle caps. Stick them lightly on the tripod point as shown. Even on a very smooth and slippery surface it makes them absolutely non-skid. When the leg or point is set in sand or soft dirt, force one or more of the corks well up on and over the point. They will steady and support the point.

Sling-Suspended Camera Makes Difficult Shots

AMATEUR photographers who wish to take pictures of eagles' nests or other objects in inaccessible places can make these difficult exposures by adapting to their use the sling device shown in the photograph at the right. Camera and photographer here shown are suspended over the Grand Canyon. The camera must of course be securely tied to the ropes, and care must be exercised in taking such pictures not to jolt the camera. The extra effort required in rigging such slings is more than repaid by the unusual photographs obtained.

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CONVERTING THE SINK INTO A PRINT WASHER

THE amateur photographer who does not own a print washer or who is in a place not equipped for photographic work, can convert the kitchen sink into an excellent washer. The only article needed is a rubber cup designed for use in flushing drain pipes. This can be obtained from any hardware store.

The cup is prepared for its new duty by cutting a hole through the handle socket into the cup opening. This is to permit water to pass through. Three or four small holes are cut in the sides of the cup, about one inch from the handle end.

In use, the cup is placed over the sink drain opening so that water can escape only through the small holes in the sides. This permits the water to collect to a depth of several inches, sufficient for washing prints.

SEND IN YOUR FAVORITE SNAP-SHOT AND WIN A PRIZE!

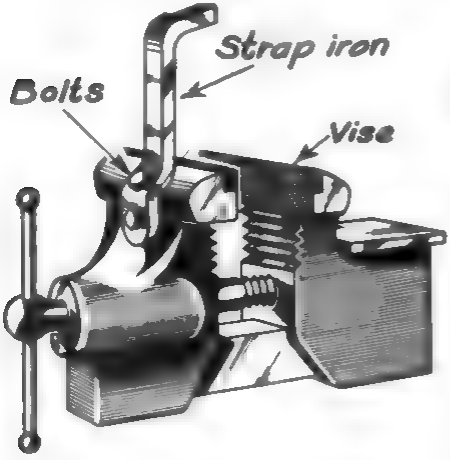
FOR THE most unusual photograph submitted each month by readers of this magazine, Modern Mechanics will pay the sum of $5. Photographs which do not win first prize, but which are considered suitable for publication, will be purchased at the regular rate of $3 each. This is your chance, you amateur photographers, to turn some of your most striking photographs into real cash. Bear in mind that your snapshots should be so striking and unusual that readers will instinctively give them a second glance. Address Modern Mechanics Magazine, Robbinsdale, Minn. Be sure to enclose return postage if you want your pictures returned to you.

Helpful Kinks for the Home Mechanic

ACCESSORY TO THE VISE

ALTHOUGH a vise will hold an object perpendicular when pressure is applied at right angles to its jaws, there is sometimes need of applying pressure the other way.

This may be done by drilling two small holes in the jaw of the vise, and bolting to



it a piece of steel several inches in width, and with an inch or more projection at the top and extending at right angles to the vise. The object to be worked will press against this projection, while the pressure of the vise jaws hold it firmly at the bottom end.

TEMPORARY SPRING REPAIR

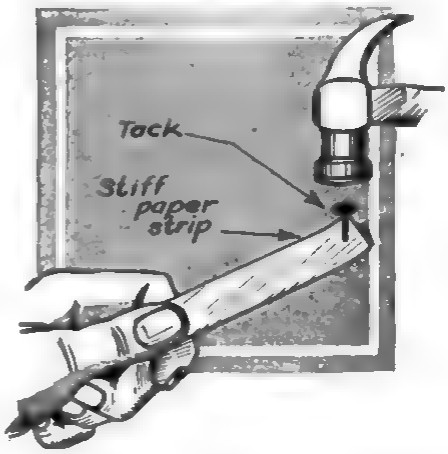
TO EFFECT a temporary repair of a fractured auto spring, take a piece of scrap iron and shape it into a brace as shown in the diagram. It can then be bolted over the break with U-bolts, and will serve until a new spring can be put in place. Two bolts should be used on each side of the break.

WIRE HOLDER AIDS IN DRIVING SCREW

IN DRIVING screws into hard wood the fingers holding the screw frequently interfere with the free manipulation of the screwdriver. To overcome this difficulty, take a straight piece of wire and bend the end into a hook as shown in the diagram.

By inserting this hook under the head of the screw it can be supported firmly and the screwdriver can be operated to best advantage.

HAMMERING KINK



TACKS which go in odd places are hard to start without mashing the fingers. A piece of heavy paper, folded once, will keep the tack supported upright until it is started into the wood with a hammer. When it has "caught" the paper may be jerked away and the tack driven home.

Exercise Wheel is Latest Health Builder

THE man-sized barrel hoop shown in the picture is a novel exercising apparatus designed by a German physical-culturist. It is known as the Leo Lip wheel, named after its inventor.

By skillful manipulation and careful balancing, the occupant of the wheel can propel himself over the ground at a rapid rate. The only method of steering the wheel is by shifting the weight of the body from one side to another.

To ride this queer unicycle, the operator steps into special foot rests fastened to the 4-inch rim and grasps the "handle bars," resting his head against a padded cushion. The wheel starts to move when the weight is thrown forward.

Experimental Rocket Cars Barred in Germany

"NO MORE rocket car trials on German soil," is the edict the German government has issued to Fritz von Opel, pioneer experimenter in the field of rocket propelled machines. The photo below shows one of von Opel's cars traveling at 160 miles an hour on a specially built track. The car later exploded, endangering spectators and killing the cat which occupied the machine.

Von Opel, however, has already perfected his rocket designs to such an extent that a rocket propelled airplane has been invented by Johannes Winter, one of his associates. The inventor and his model are shown in the upper corner of the photograph. A company for the manufacture of the rocket planes is being planned.

—Opel Car Photo from Times-Wide World.

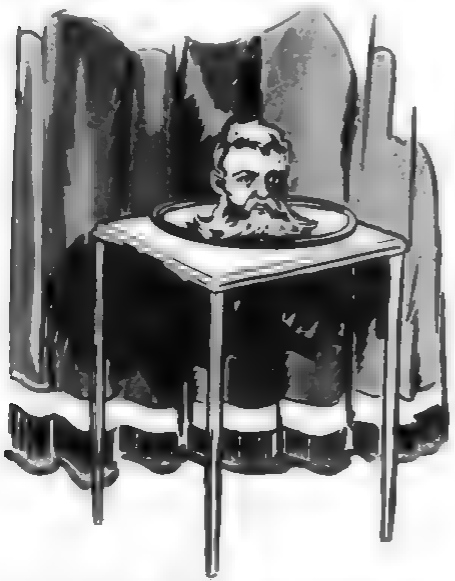
Powder explosions supply the driving force of the Opel rocket car shown above. Fritz von Opel, the designer, is shown in the circle. Above is Johannes Winter with his model rocket air plane, propelled by compressed air instead of explosives.

Conducted by **MAHMUD SINGH**

Magic in all its phases is the province of Mahmud Singh, conductor of this department, whose long experience as a practitioner of Oriental magic has left him a master of the illusionist's art. From his earliest childhood in Delhi, India, where he studied under Oriental magicians, he has been performing and inventing new illusions. Every month he presents in this department tricks which the amateur can easily perform.

Mystifying "Head on a Platter" Illusion

ONE of the most mystifying of illusions, yet one which does not require elaborate equipment to effect, is that known to professional magicians as the "John the Baptist" trick. The audience, as it thinks, sees a living human head, unconnected with a visible body, lying on a table top. The head speaks, smiles, winks its eyes, and in various ways gives unquestionable evidence that it is alive. How is this startling effect produced?



How did the live human head get on the platter? Mahmud Singh explains this astonishing illusion in this article.

To begin with, the audience does not see what it thinks it sees. This is the basis of all successful illusions. The head on the platter is of course connected with a human body which is hidden from view. The trick is effected by the use of mirrors and does not require any sleight of hand work, making it an ideal stunt for the amateur.

As shown in the drawing, a small table is placed on the stage. Curtains or draperies, preferably of plain color, are hung on three sides of the stage so that the table is surrounded by the hangings. A hole in the table top large enough to admit an actor's head is cut through, and the actor takes his seat under the table with his head projecting through the hole.

To hide the actor's body, two mirrors are placed between the legs of the table facing towards the audience. The table must be placed at an angle showing only two sides,

as shown in the drawing. In addition to hiding the actor, the mirrors reflect the curtains on either side, so that from the front the hangings seem to run continuously right behind the table, presenting the illusion of the detached head. An observing eye will notice that only three table legs are visible, the fourth being hidden by the mirrors which also hide the actor.

The amateur who wishes to give an added effectiveness to the illusion can enlist the services of a dancer to enact the old story of Salome and John the Baptist in which the Biblical character is beheaded. Other elaborations will suggest themselves to the young magician who studies the possibilities of this effective trick.

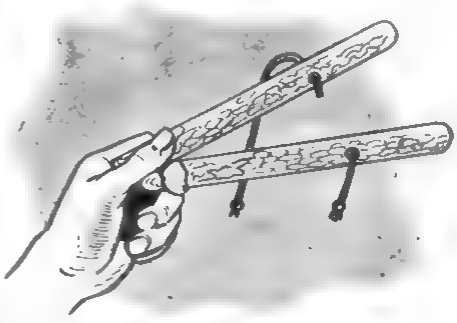
"Pillars of Solomon" Deceptive Trick

A TRICK which for years has been a favorite of conjurors is known as the "Pillars of Solomon." In its simplest form it consists of two blocks of wood about six inches long, from the sides of which, near the top, two strings project. When one string is pulled, the other shortens itself proportionately so that the strings appear to be of one piece. Yet when the conjuror runs a knife between the two and displays the severed ends of the cord, he is still able to cause one string to shorten itself when the other is pulled out. The secret, of course, is easily guessed—the string *is* one piece, running down to the lower ends of the wooden blocks and being fastened at the bottom. The performer of course cannot separate the two sticks, which is a weakness of the trick as usually presented.

We present herewith an improvement on the original trick. The diagram shows how the apparatus is prepared. Obtain two pieces of box elder or other wood from which the pithy center can easily be removed. Cut a hole through the side of the wood and run a cord through it. The lower end of the cord must be weighted. A good weight can be made from tinfoil rolled into a ball, through which the cord is threaded. A drilled bullet or other heavy object can also be used.

Then draw the cord up through the hole and cut it off so that it is about 6 inches long. Tie a knot in the loose end so it cannot slip out of reach. The open ends of the piece of wood can be filled with corks and the end covered with sealing wax to give the apparatus a finished look.

In performing the trick some skill is required. One cord must be pulled out and at the same time the other piece of wood is



raised slightly so that the weight on the cord will cause it to slide down, pulling the cord into the wood. This maneuver must be timed carefully so that the two motions will occur at the same moment, giving the illusion that the strings are connected.

If a bit of frayed cord end is glued to the sides of the wooden blocks, the performer can run a knife between the two batons and display the severed strings.

A dramatic twist can be given to the trick if the magician holds the two sticks close together when he first performs the illusion. Some of the keen-eyed members of the audience are sure to guess that the strings are connected at the bottom of the wooden pieces. If nobody volunteers that he has guessed the answer, the performer can request the audience to give its ideas as to how the stunt is accomplished. With seeming chagrin the magician listens to the guesses, which have apparently penetrated his secret —and then, holding the sticks far apart, he repeats the trick, proving the guesses to be wrong.

CONQUEST of the MOON

(Continued from page 145)

was led by Gapth, who narrated my capture and the escape of Nah-ee-lah.

"We will hold him for questioning by The Twentyfour," he said. "If he is not of Va-nah he is neither Kalkar nor Laythean, and consequently, he must be flesh of a lower order and therefore may be eaten." He paused a moment and fell to examining a large book which seemed to be filled with plans upon which strange hieroglyphics appeared. He turned over several leaves, and finally coming evidently to the page he sought, he ran a forefinger slowly over it until it came to rest near the center of the plat. "You may confine him here," he said to Gapth, "in chamber eight of the twenty-fourth section, at the seventh elevation, and you will produce him upon orders from The Twentyfour when next they meet."

I went, following Gapth and the others who had conducted me to the presence of this creature. They led me back into the very corridor from which we had emerged upon the terrace and then straight into the heart of that amazing pile for fully half a mile, where they shoved me roughly into an apartment at the right of the corridor with the admonition that I stay there until I was wanted.

History of Laythe

I FOUND myself in a dimly lighted, rectangular room, the air of which was very poor, and at the first glance I discovered that I was not alone, for upon a bench against the opposite wall sat a man. He looked up as I entered and I saw that his features were very fine and that he had black hair like Nah-ee-lah.

"You, too, are a slave?" he asked.

"I am not a slave," I replied, "I am a prisoner."

"It is all the same," he said; "but from whence come you? I have never seen your like before in Va-nah."

"I do not come from Va-nah," I replied, and then I briefly explained my origin and how I came to be in his world. He did not understand me, I am sure, for though he seemed to be, and really was, highly intelligent, he could not conceive of any condition concerning which he had had no experience and in this way he did not differ materially from intelligent and highly educated Earth men.

"There is no escape, I imagine, from this Kalkar city, is there?" I asked.

"No," he said, "none whatever. There is only one avenue and we are so confused when we are brought into the city that it would be impossible for us to find our way out again through this labyrinth of corridors and chambers."

"And if we did win our way to the outer world we would be as bad off, I presume, for we could never find Laythe, and sooner or later would be recaptured by the Kalkars or taken by the Va-gas. Am I not right?"

"No," he said, "you are not right. If I could reach the rim of the crater beyond this city I could find my way to Laythe. I know the way well, for I am one of Ko-tah's hunters and am thoroughly familiar with the country for great distances in all directions from Laythe."

So this was one of Ko-tah's men. I was glad, indeed, that I had not mentioned Nah-ee-lah or told him of her possible escape, or of my acquaintance with her.

"I can find the way to the mouth of the tunnel where it opens into the crater," I told him. "But how can we reach it unarmed through a city populated with our enemies who would slay us on sight?"

"There are never very many people in the chambers or corridors far removed from the outer terraces, and if we were branded upon the forehead, as accepted slaves are, and your apparel was not so noticeable, we might possibly reach the tunnel without weapons."

While we were still discussing our chances of escape, two slaves brought us food in the shape of raw vegetables and fruit.

After eating I became sleepy and was about to stretch out upon the floor of our prison when my companion, whose name was Moh-goh, told me that there was a sleeping apartment adjoining the room in which we were, that had been set apart for us.

(Continued on page 184)

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Conquest of the Moon

(Continued from page 182)

The doorway leading to the sleeping chamber was covered by heavy hangings, and as I parted them and stepped into the adjoining chamber, I found myself in almost total darkness, the walls and ceiling of this room not having been treated with the illuminating coating used in the corridors and apartments which they wished to maintain in a lighted condition. How long I slept I do not know, but I was awakened by Moh-goh calling me. He was leaning over me, shaking me by the shoulder.

"You are wanted," he whispered. "They have come to take us before The Twenty-four."

"Who are The Twentyfour?" I demanded.

"They compose the committee that rules this Kalkar city."

I was thoroughly awakened now and rose to my feet, following him into the adjoining chamber, where I saw two Kalkar warriors standing impatiently awaiting us. As I saw them a phrase leaped to my brain and kept repeating itself: "There are but two, there are but two."

They were across the room from us, standing by the entrance, and Moh-goh was close to me.

"There are but two," I whispered to him in a low voice. "You take one and I will take the other. Do you dare?"

"I will take the one at the right," he replied, and together we advanced across the room slowly toward the unsuspecting warriors. The moment that we were in reach of them we leaped for them simultaneously. I did not see how Moh-goh attacked his man, for I was busy with my own, though it took me but an instant to settle him, for I struck him a single terrific blow upon the chin and as he fell I leaped upon him, wresting his dagger from its scabbard and plunging it into his heart before he could regain his senses from the stunning impact of my fist. Then I turned to assist Moh-goh, only to discover that he needed no assistance, but was already arising from the body of his antagonist, whose throat was cut from ear to ear with his own weapon.

"Quick!" I cried to Moh-goh, "drag them into the sleeping apartment before we are

by EDGAR RICE BURROUGHS

discovered"; and a moment later we had deposited the two corpses in the dimly lighted apartment adjoining.

"We will leave the city as Kalkar warriors," I said, commencing to strip the accoutrements and garments from the man I had slain.

"Lead the way," said Moh-goh, "and if you can find the crater I can assure you that I can find Laythe."

We traveled a considerable distance without meeting anyone, and at last reached the chamber in which I had been blindfolded. As we entered it I saw fully a score of Kalkars lolling upon benches or lying upon vegetation that was piled upon the floor. They looked up as we entered, and at the same time Moh-goh stepped in front of me.

"Who are you and where are you going?" demanded one of the Kalkars.

"By order of The Twentyfour," said Moh-goh, and stepped into the room. Instantly I realized that he did not know in which direction to go, and that by his hesitancy all might be lost.

The Spear-Ladder

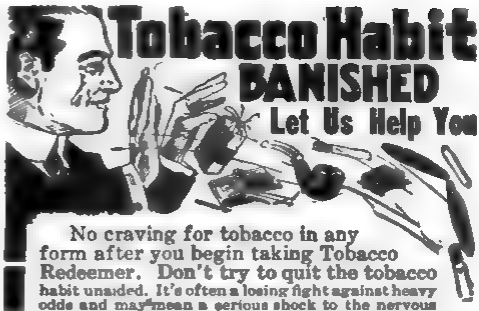
"STRAIGHT ahead, straight across the room," I whispered to him, and he stepped out briskly in the direction of the entrance to the tunnel. Fortunately for us, the chamber was not brilliantly lighted, and the Kalkars were at the far end of it; otherwise they must certainly have discovered my deception, at least, since any sort of close inspection would have revealed the fact that I was not a Va-nah. However, they did not halt us, though I was sure that I saw one of them eyeing me suspiciously, and I venture to say that I took the last twenty steps without drawing a breath.

It was quickly over, however, and we had entered the tunnel which now led without further confusing ramification directly to the crater.

"We were fortunate," I said to Moh-goh.

"That we were," he replied.

In silence, then, that we might listen for pursuit, or for the sound of Kalkars ahead of us, we hastened rapidly along the descending passageway toward the mouth of the tunnel where it opened into the crater:



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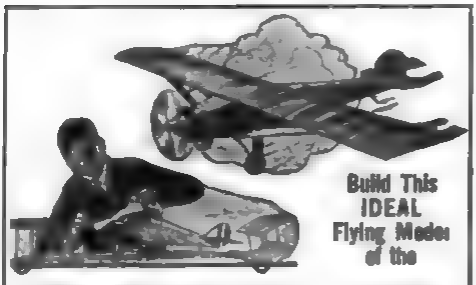

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Conquest *of the* Moon

and at last, as we rounded the last turn and I saw the light of day ahead of me, I breathed a deep sigh of relief, though almost simultaneously my happiness turned to despair at the sudden recollection that there were no hooked poles here to assist us to the summit of the crater wall. What were we to do?

"Moh-goh," I said turning to my companion as we halted at the end of the tunnel, "there are no poles with which to ascend. I had forgotten it, but in order to prevent the Kalkars from ascending after me, I threw all but one into the abyss, and that one slipped from the rim and was lost also, just as my pursuers were about to seize me."

"Oh, we can overcome that," replied my companion. "We have these two spears, which are extremely stout, and inasmuch as we shall have plenty of time, we can easily arrange them in some way that will permit us to ascend to the summit of the crater. It is very fortunate that we were not pursued."

The Kalkar's spears had a miniature crescent-shaped hook at the base of their point similar to the larger ones affected by the Va-gas. Moh-goh thought that we could fasten the two spears securely together and then catch the small hook of the upper one upon the rim of the crater, testing its hold thoroughly before either of us attempted to ascend. Beneath his tunic he wore a rope coiled around his waist which he explained to me was a customary part of the equipment of all Laytheans. It was his idea to tie one end of this around the waist of whichever of us ascended first, the other going as far back into the tunnel as possible and bracing himself, so that in the event that the climber fell, he would be saved from death, though I figured that he would get a rather nasty shaking up and some bad bruises, under the best of circumstances.

I volunteered to go first and began fastening one end of the rope securely about my waist while Moh-goh made the two spears fast together with a short length that he had cut from the other end.

Having fastened the rope to my satisfaction, I stood as far out upon the ledge before the entrance to the tunnel as I safely could, and with my back toward the crater looked

by EDGAR RICE BURROUGHS

up at the rim twenty feet above me, in a vain attempt to select from below, if possible, a reasonably secure point upon which to hook the spear. As I stood thus upon the edge of eternity, steadying myself with one hand against the tunnel wall, there came down to me from out of the tunnel a noise which I could not mistake. Moh-goh heard it, too, and looked at me, with a rueful shake of his head and a shrug of his shoulders.

"Everything is against us, Earth man," he said, for this was the name he had given me when I told him what my world was called.

The Mile-High City

THE pursuers were not yet in sight, but I knew from the nearness of the sound of approaching footsteps that it would be impossible to complete the splicing of the spears, to find a secure place for the hook above, and for me to scramble upward to the rim of the crater and haul Moh-goh after me before they should be upon us. As I stood there with bent head, my eyes cast upon the floor of the tunnel, they fell upon the neatly coiled rope lying at my feet, one end of which was fastened securely about my waist. Instantly there flashed into my mind a mad inspiration. I glanced up at the overhanging rim above me. Could I do it? There was a chance—the lesser gravity of the Moon placed the thing within the realm of possibility, and yet by all earthly standards it was impossible. I stooped low, then, and concentrating every faculty upon absolute coordination of mind and muscle, I leaped straight upward with all the strength of my legs.

My leap carried me above the rim of the crater, where I lunged forward and fell sprawling, my arms and upper body upon the surface of the ground. Instantly I turned about and lying upon my belly, seized the rope in both hands.

"Quick, Moh-goh!" I cried to my companion below; "make the rope fast about you, keep hold of the spears and I will drag you up!"

"Pull away," he answered me instantly, "I have no time to make the rope fast about me. They are almost upon me."

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Conquest *of the* Moon

I did as he bade, and a moment later his hands grasped the rim of the crater and with my assistance he gained the top, dragging the spears after him. For a moment he stood there in silence looking at me with a most peculiar expression upon his face; then he shook his head.

"I do not understand, yet," he said, "how you did it, but it was very wonderful."

I can assure you that I felt much better, now that I was armed with a spear and a knife, and as we walked I practiced casting stones, at Moh-goh's suggestion and under his instruction, until I became rather proficient in the art.

I shall not weary you with a narration of our journey to Laythe. How long it took, I do not know. It may have consumed a day, a week, or a month, for time seemed quite a meaningless term in Va-nah, but at length, after clambering laboriously from the bottom of a deep gorge, we stood upon the edge of a rolling plateau, and at some little distance beheld what at first appeared to be a cone-shaped mountain, rising fully a mile into the air above the surface of the plateau.

"There," cried Moh-goh, "is Laythe! The crater where lies the entrance to the tunnel leading to the city is beyond it."

As we approached the city, the base of which we must skirt in order to reach the crater beyond, I was able to obtain a better idea of the dimensions and methods of construction of this great interior lunar city, the base of which was roughly circular and about six miles in diameter, ranging from a few hundred to a thousand feet above the level of the plateau. The base of the city appeared to be the outer wall of an ancient extinct volcano, the entire summit of which had been blown off during some terrific eruption of a bygone age. Upon this base the ancient Laytheans had commenced the construction of their city, the houses of which rose one upon another as did those of the Kalkar city from which we had just escaped. The great age of Laythe was attested by the tremendous height to which these superimposed buildings had arisen, the loftiest wall of Laythe now rising fully a mile above the floor of the plateau.

When we had reached a point near the

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Conquest *of the* Moon

base of the city, I saw that we had been discovered, for directly above us there were people at various points who were unquestionably looking down at us and commenting upon us.

Even as I watched a swarm of winged men swept over the highest terrace of the city and came diving down upon us. In their hands they brandished spears, their barbed points glistening in the light—spears which would pass clean through us if they scored a hit, leaving us gasping out our lives on the purple sward of an alien planet.

Weaponless, without any means of defense except my own two hands, I will confess that I was frightened. But there was no retreat—nothing we could do but stand our ground. Moh-goh, watching the defenders of Laythe swooping down upon us, stood immovable as a statue. He knew, of course, that unless the winged warriors recognized him as a Laythean, we were both doomed. Wearing the garments of a Kalkar slave as he was, the chance of such recognition was indeed remote.

"Good-bye, Earth Man," said Moh-goh. Then he turned his back on me and shook his fists at the swooping guards of Laythe.

They were so close now that I could hear the beating of their wings, sounding in my ears like the hum of angry hornets. One huge winged fellow, apparently the leader, drew back his arm. A shaft of light shot from his fingers. Scarcely a yard from my side his spear buried itself for half its fearsome length in the purple turf. His lance had missed me. But the others would not miss.

On the instant a score of winged arms crooked back their elbows, aiming their spears at me and Moh-goh. Helplessly we crouched there, waiting for the signal of death to issue from the lips of the Laythean leader.

(To be continued)

Julian and Moh-goh escape the lances of the Winged Men, only to encounter a marvelous airship invented by Orthis, capable of turning the City of Laythe into dust. Be sure to read the next installment of this great serial in the January issue, on all newsstands December 1.

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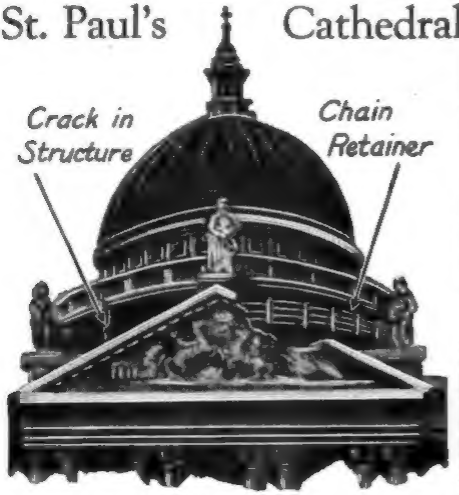
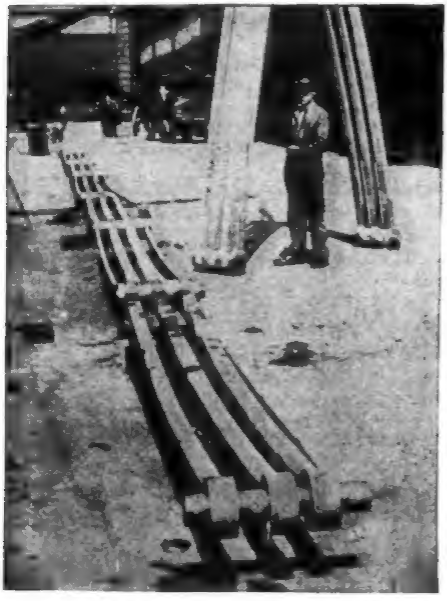


A STEEL retaining chain has been built to encircle the base of St. Paul's Cathedral Dome in London, which has been sagging dangerously owing to the settling of the building on its foundations. Below is shown a close-up view of the huge bracelet, whose huge size is shown in comparison with the figure of the man between two of the links.



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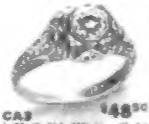

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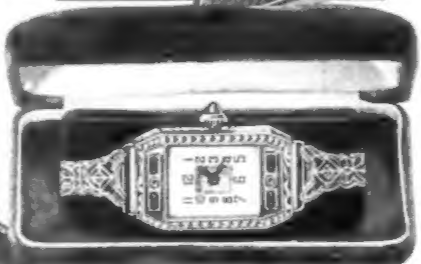

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